
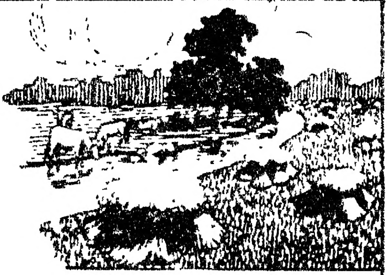

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BARLEY COMPARED TO CORN IN DAIRY RATIONS

Experimental Work Shows Barley Compares Favorably With Corn for Feeding Dairy Cows

J. E. BURNETT AND O. E. REED, DAIRY SECTION

The corn borer's invasion of Michigan and the consequent demands for information relative to possible substitutes for corn in the grain ration of dairy cattle has prompted this experimental trial in which barley was compared with corn as a feed for dairy cows.

The composition of barley is such as to indicate that the feeding value would be slightly less than that of corn since while one hundred pounds of barley contain about two pounds more digestible crude protein, it may contain five pounds less total digestible nutrients.

Previous Feeding Work With Barley

It has been the experience of many farmers that barley may be substituted in the grain ration of dairy cows in the place of corn. There is, however, little experimental data to support the result of practical feeding. Morrison, Humphrey, and Hulce of the Wisconsin Experiment Station found ground barley equal to ground corn.

The experimental trials reported below were conducted at the College during the period from March 10 to June 8, 1927. Ten cows, nine pure bred Holsteins and one Ayrshire, were selected from the College dairy herd and divided into two lots of five cows each. Care was taken to select groups of cows that were comparable as far as milk production, stage of lactation, age, and other factors that might influence the trial.

Rations Fed During Experiment

All cows were fed roughage at the rate of one pound of hay and three pounds of silage for each hundred pounds of live weight. Grain was fed to the Holsteins at the rate of one pound to three and one-half pounds of milk produced and to the Ayrshire at the rate of one pound of grain to each three pounds of milk produced. The cows were weighed each day at the same time. Changes in amounts of grain and roughage fed were made at the end of ten day periods. The cows were fed alfalfa hay of good quality and well matured corn silage throughout the trial. The corn grain ration consisted of 400 pounds ground corn, 300 pounds of ground oats, 200 pounds

bran, and 100 pounds of Old Process linseed oil meal. The barley grain ration was the same except that ground barley was substituted for the ground corn.

Rations Changed to Check Results

During the first thirty days of the trial, Lot I was fed the corn ration and Lot II was fed the barley ration. During the second thirty days, Lot I was fed the barley ration and Lot II the corn ration. During the third thirty day period, Lot I was returned to the corn ration and Lot II to the barley ration. The first ten days of each period was regarded as a transition period and not included in the final results.

Since cows tend to decrease in their milk production as lactation advances, and, since this is a fairly uniform factor, the average production of each lot of cows during the first and third periods should equal the production of the same cows during the second period if there is no change in production due to change in feeding.

The following table gives the results of the experiment:

Lot I—5 cows—twenty day period	Lbs. milk	Lbs. fat	Body weight
Period:			
1 Corn in grain ration	4392 3	136 7	6375
2 Barley in grain ration	3993 1	123 2	6370
3 Corn in grain ration	3739 0	114.4	6342
Average 1st and 3rd periods, corn ration:	4065.7	125.5	6359
Second period, barley ration	3993.1	123.2	6370
Difference in favor of corn	72 6	2 3	−11
Lot II—5 cows—twenty day period			
Period:			
1 Barley in grain ration	4391.1	137.1	6373
2 Corn in grain ration	4055 1	120 7	6359
3 Barley in grain ration	3783.4	115.9	6319
Average 1st and 3rd periods, barley ration	4087.3	126.5	6346
Second period, corn ration	4055.1	120.7	6359
Difference in favor barley ration	32.2	5.8	−13

Summary of Tabulated Data

A study of the above table shows that the five cows in Lot I produced a total of 72.6 pounds of milk and 2.3 pounds more butter fat during the average 20-day period when on the corn ration than they produced during the intervening 20-day period when on the barley ration. The average weight of the five cows however, was 11 pounds greater during the 20 days they were on the barley ration. The five cows in Lot II produced a total of 32.2 pounds more milk and 5.8 pounds more butterfat during the average 20-day period when on the barley ration than they produced while on the corn ration. The average weight of the five cows in this lot, however, was 13 pounds greater during the 20 days they were on the corn ration.

Conclusion

The data show that the cows in Lot I produced more milk and butter fat on the ration containing corn and the cows in Lot II produced more milk and butter fat on the ration containing barley. Therefore, it can be concluded that the two grain rations are about equal in feeding value and that barley may be substituted for corn in the grain ration of the dairy cow.

THE IRIS BORER NOW ATTRACTS ATTENTION

This Insect Does Considerable Damage to Fleshy Stemmed Flowering Plants

EUGENIA MC DANIEL, ENTOMOLOGICAL SECTION

Since the European corn-borer has arrived in Michigan, people have been watching for larvae or caterpillars tunneling in fleshy stemmed plants. Many larvae previously ignored are now receiving their share of attention, and, among these, is the Iris borer, *Marconoctua onusta.*

The adult of the Iris borer is an inconspicuous moth or miller which appears in the fall when the females deposit their eggs on the leaves and stalks of lilies. Both wild and cultivated plants are infested. Winter is passed in the egg stage on the leaves of the plant. When spring comes and new

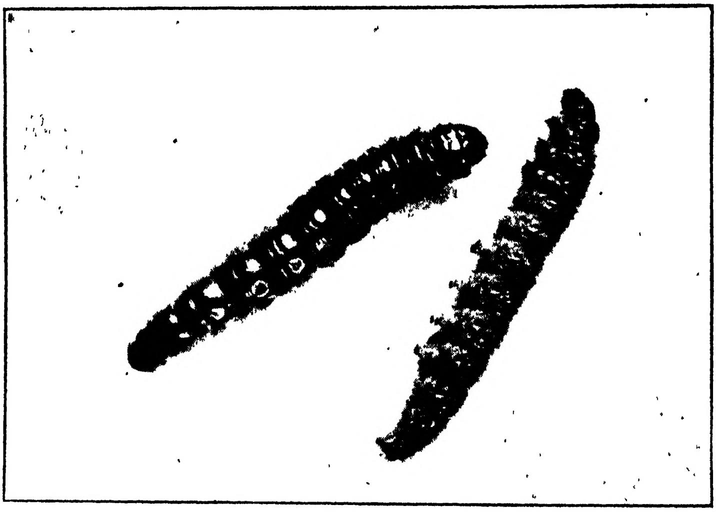


Fig. I.—Iris borer slightly enlarged.

growth starts, these eggs hatch and the young begin working in the root and about the crown of the plant. At first, while the larvae are small, very little damage to the plant is noted, but, as the larvae increase in size, dead leaves begin to appear here and there throughout the plant. On examination of the roots, it will be found that they are badly tunneled and that decay has set in.

Description of Larvae

The mature caterpillar measures about two inches in length and is ornamented along the sides with rows of black spots. It varies somewhat as to color, some individuals being drab cream colored creatures, while others have a decided pinkish bloom.

This caterpillar should never be confused with that of the European corn-

Fig. II.—Iris plant showing effects of borer.

borer, since it appears in the season before the latter has hatched from the egg or while it is still very small. Later in the summer the fact that the larvae of the Iris borers have practically completed their growth, serves to mark the distinction between the two species. The larva of the Iris borer when mature, goes into a pupal or resting stage. It remains in this state a few weeks and then the adults appear.

Control Measures

Obviously, the most effective control measure would be to rake up and destroy by fire or composting all last year's plant growth early the following spring. This will destroy the eggs and reduce the number of borers that would otherwise hatch.

Where the borers are detected in growing plants they, the borers, should be dug out and destroyed. If the infestation is too severe the plant itself should be dug up and burned.

HOGGING OFF CORN RETURNS GOOD PROFIT

Comparison Made of Value of Soy Beans, Rape, and Tankage Supplements*

W. E. J. EDWARDS AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

In order to ascertain if it is advisable, when hogging off corn, to purchase the protein needed, in the form of tankage, or grow it in the form of rape or soy beans, a series of experiments is being conducted at this Station. The results of the experimental work in 1926 are reported below.

Three lots of one acre each were planted May 21, 1926, with eight and two-thirds pounds per acre of Post's yellow dent corn. Lot 1 was sown with Dwarf Essex rape at the rate of eight pounds per acre immediately after the last cultivation of the corn. Lot 2 was planted with Manchu soy beans at the rate of nine and one-half pounds per acre immediately after the corn was sown. No other feed except minerals was given the pigs placed in these two lots. The pigs in Lot 3 had access to 60 per cent tankage in a self-feeder as well as to the mineral mixture.

The mineral mixture used consisted of 45 pounds steamed bone meal, 20 pounds pulverized limestone, and 30 pounds common salt placed in self-feeders. Water was available at all times in an automatic waterer placed in each lot. Each group of pigs was given a shelter with straw for bedding.

When the pigs were turned in, the corn on each lot was mature enough to keep in normal weather if cut and shocked. There was an abundance of rape in Lot 1 throughout the entire experiment.

The soy beans in Lot 2 were well filled and most of them were ripe enough to pull, although there were many green leaves on them in several parts of the lot, when the pigs were turned in. Practically no leaves, but considerable soy bean grain was left at the close of the experiment.

Conclusions

1. One acre of corn yielding 37.70 bushels with rape fed 9 pigs 29 days; one acre of corn yielding 38.50 bushels with tankage fed 9 pigs 28 days and one acre of corn yielding 31.06 bushels with soybeans fed 9 pigs 27 days.
2. Very satisfactory gains were made by all the pigs, especially those in the tankage and rape lots.
3. There was little difference in the feed requirements for 100 pounds of gain of the different groups of pigs.

*According to the Corn Borer regulations all corn stalks in quarantined areas must be completely plowed under or burned before May 1 of the following year.

TABLE I.—SUMMARY OF EXPERIMENT

Nine pigs in each lot	Lot 1 standing corn	Lot 2 standing corn	Lot 3 standing corn
	Rape, minerals, self-fed	Standing soy-beans, minerals, self-fed	Tankage, minerals, self-fed
Area of lot	1 acre	1 acre	1 acre
*Yield of corn	37.70 bu.	31.06 bu.	38.50 bu.
Feeding period	Oct. 7—Nov. 5	Oct. 7—Nov. 3	Oct. 7—Nov. 4
Number of days	29	27	28
Av. initial weight (lbs.)	140.77	141 44	142 88
Av. final weight (lbs.)	188.77	180 00	192 44
Gains made on one acre	432	347	446
Av. daily gain (lbs.)	1 656	1 428	1 770
Av. daily feed consumed (lbs.):			
Corn	8 395	7 304	8.825
Tankage	....	....	.321
Minerals	019	023	.010
Total	8 414	7 327	9.156
Feed required for 100 lbs gain (lbs.)			
Corn	507 18	511 53	498 65
Tankage	....	....	18 16
Minerals	1 157	1 585	561
Total	508 34	513 11	517 37
†Value of gains produced at $12.05 per 100 lbs	$50 44	$40 52	$52 08
‡Value of additional feed fed:			
Tankage	....	....	$3 04
Minerals	$0 08	$0 09	04
Extra corn fed	1 20	54	1 02
Total	1 28	63	4 10
Value of gains produced by one acre of standing corn after deducting cost of additional feed, hogs selling at $12.05 per 100 lbs	49 16	39 89	47 98
§Considering feed cost only, value returned by hogs for each bushel of corn consumed.			
Hogs selling at $12.05 per 100 lbs	1 30	1 28	1 25
Hogs selling at $10.00 per 100 lbs	1 08	1 06	1 02
Hogs selling at $8.00 per 100 lbs	85	85	79

*Calculated on a 15.5 per cent moisture basis after husking, weighing and analysing two representative rows of corn from each lot. This corn or its equivalent was fed back to the hogs in the lots from which it was taken.
†Price received after deducting shipping and selling charges.
‡Tankage at $75.00 per ton, corn at 84c per bu., minerals at $30 per ton.
§Shipping shrinkage of 3.1 per cent deducted from actual gains made.

4. The value returned per bushel of corn consumed differed but little in the three lots.

5. Although the tankage fed pigs returned a slightly lower value per bushel of corn consumed, after paying for the tankage eaten, these pigs showed a keener appetite, and gained more rapidly than did the others. According to this experiment tankage fed in the cornfield enables the pigs to harvest the corn crop more quickly and finishes them for an earlier fall market.

6. The values returned by the hogs for the corn consumed, indicates that hogging down corn is a rapid and economical method of converting this crop into pork.

It is now too late to sow soybeans in the cornfield for hogging off. Rape, if not sown at corn planting time, should not be sown until immediately after

the last cultivation of the corn. It may be broadcasted at the rate of about 8 pounds per acre.

When corn is to be hogged off, if rape is not sown or if some other good forage such as alfalfa, red clover, or soybeans is not readily accessible, this experiment indicates that tankage can be fed with the corn very profitably. A good protein supplement supplied with the corn reduces the feed requirements for 100 pounds of gain and produces more rapid gains than when corn alone is available. Rapidity of gains is of considerable importance as the earlier in the fall the hogs are marketed the higher will be the price received.

YIELD FROM SCARIFIED SEED NOT ALWAYS HIGHER

Tests Show Approximately Same Yields From Unscarified Northern Grown Common Alfalfa Seed in Five Year Trials

C. R. MEGEE, FARM CROPS SECTION

The scarification of alfalfa and sweet clover seed has become an established trade practice among many seedsmen. Many comparisons have been made between the germination of scarified and unscarified seed and in the majority of cases the scarified alfalfa and sweet clover seed gave the higher immediate germination. This is especially true of northern grown seed and much less true of southwestern grown alfalfa seed.

Scarified Seed Deteriorates More Rapidly

Since most seedsmen sell seed on a germination test, scarification of alfalfa and sweet clover seed has been the usual practice to obtain a high percentage of germination. This does not necessarily mean that the scarified seed will produce higher yields of hay than unscarified seed. The amount of seed sown per acre and the conditions under which the seed were sown quite likely influence the relative yields to some extent. It has been shown that scarification causes seed to deteriorate more rapidly when stored for a year or more and under trade conditions it is frequently desirable to have a carry-over of seed from one season to the next.

Recently the question has been frequently raised whether scarification was necessary under field conditions. In 1921, an extensive variety and strain test of alfalfa was seeded, and, among a number of other strains, 17 lots of Common Northern grown seed from 17 different sources were included.

Four plots of each common strain were seeded, two plots being sown with scarified seed and two plots with unscarified seed. A plot of scarified was always adjacent to a plot of unscarified seed. The seed was sown at the rate of 15 pounds per acre on all of the plots. These plots have been harvested for hay for five years. All plots have been harvested at the same time, have received the same treatment, and all yields of hay have been based on a 12 per cent moisture content.

YIELD OF HAY—TONS PER ACRE—12 PER CENT MOISTURE

	1922	1923	1924	1925	1926	Ave. 5 yrs.
Scarified—Average of 14 plots....................	5.14	6.30	7.16	2.31	2.71	4.72
Unscarified—Average of 14 plots..................	4.97	6.13	7.19	2.43	2.63	4.67

Only Slight Difference in Yields

The above data shows that in this test the scarified and unscarified seed gave practically the same yields each year and that the five-year average yields are practically the same. Under the conditions under which this test was conducted there was no appreciable difference in the yield of scarified and unscarified northern grown Common alfalfa seed.

TESTS OF RATIONS FOR FINISHING BABY BEEF

Linseed Meal Improves the Ration—Barley Not As Good As Corn

G. A. BROWN AND G. A. BRANAMAN, ANIMAL HUSBANDRY SECTION

The data presented in this article represent the fourth trial at the Michigan Experiment Station in fattening baby beef calves for market. Reports of previous experiments may be found in the Quarterly Bulletins for August of the three preceding years.

The calves used in the experiment were purchased on the Chicago market October 12, 1926, half of them being heifers and half steers. There were no calves that would grade as fancy feeders, but a few were in the choice class, a few in the medium class and the most of them in the good class of feeder calves when graded by a committee of three representing the Michigan Experiment Station and the Bureau of Animal Industry and Bureau of Agricultural Economics, United States Department of Agriculture. Some showed indications of Hereford breeding, some Aberdeen Angus, and others Shorthorn.

After arrival at the Experiment Station feed lots, they were tested for tuberculosis and dehorned. Mixed hay and corn silage with later a small amount of grain were fed until November 4, when they were started on experimental feed. The calves were divided into three lots, five steers and five heifers in each lot, and as nearly equal as possible according to breeding, type, quality, condition, age, and weight. Individual weights were taken for three successive days at the beginning and at the close of the trial, with a weight every ten days during the feeding period.

The cost in the feed lots on November 4 was $9.50 per cwt., including cost in Chicago, purchasing, and shipping expense, preliminary feed, and veterinary expense.

Objects of Experiment

1. Comparison of ground barley and shelled corn when fed with corn silage and alfalfa hay.
2. Comparison of linseed meal and alfalfa hay as the source of protein.

Rations Fed

Lot 1. Ground barley—silage—alfalfa.
Lot 2. Shelled corn—linseed meal—silage—alfalfa.
Lot. 3. Shelled corn—silage—alfalfa.

A mixture of equal parts bonemeal and salt was kept before them in boxes, and water was supplied in tubs. They were housed in a shed with

doors to small lots on the east always open. The calves in each lot received all the silage they would clean up readily twice daily, and alfalfa hay was kept before them in racks.

A mixture of equal parts by weight of whole oats and ground barley (or shelled corn) was fed the first 60 days, three parts barley (or corn) and one part oats the next 30 days, and barley (or corn) alone the last 120 days. About 6 pounds of grain per calf per day was fed during the first 60 days, 8 pounds the next 50 days, 9.5 pounds the next 40 days and 10.5 pounds the last 60 days.

One pound of grain in lot 2 was replaced by a pound of linseed meal during the first 100 days, 1½ pounds the next 70 days and 2 pounds the last 40 days.

Lot 1 and lot 3 would not take a larger amount of grain later in the period. However, lot 2 seemed eager for more and they were given 11 pounds of corn in addition to 2 pounds of linseed meal during the last month.

Little Grain Wasted by Calves

Two 40 pound pigs were put in each lot and were fed shelled corn and tankage at night according to appetite. Those in the barley lot got very little grain from the droppings and in the other lots there was hardly enough to full feed one pig, however, it was worth saving.

Table I shows a summary of the results obtained.

Linseed Meal Profitable Again

The comparison of lot 2, receiving linseed meal, with lot 3, not receiving the linseed meal, is comparable to those lots in the three preceding trials. The calves in the two lots were fed as nearly alike as possible except for the substitution of the linseed meal in lot 2 for an equal weight of corn in lot 3.

The calves receiving the linseed meal ate more silage throughout the feeding period, and toward the end they readily took some additional grain. They were always ready for their feed and every calf stayed for the finish. Those in lot 3, not receiving the linseed meal, refused to take as much grain and were very easily thrown off feed. Some of them ate very well, gained well, and showed practically as good a finish as those receiving the linseed meal, but others did not do nearly as well. We have found these things to be characteristic of calves fed on these two rations in each trial.

The linseed meal calves also made enough greater gain in weight so that the cost of feed for each hundred pounds of gain, crediting the feed saved by the pigs, is exactly the same in each lot. The necessary selling price in the lots to pay for the calves and for the feed is practically the same. The actual selling value placed on them by a commission salesman and a packer buyer from Detroit, however, was 50 cents per cwt. higher for the calves fed linseed meal. In the end they returned $4.66 per head more above feed costs, or 25 cents per bushel more for each bushel of shelled corn fed.

Shelled Corn More Efficient Than Barley

The calves in lot 1, receiving the ground barley, were fed as nearly as possible like those in lot 3, receiving the shelled corn. However, the barley

TABLE I.—SUMMARY OF RESULTS

Ten calves per lot—2 pigs per lot—Grain rations	210 days Lot 1 Gr. barley	Nov. 4, 1926—June 2, 1927 Lot 2 Sh. corn, linseed, meal	Lot 3 Sh. corn.
Initial weight per calf	379.7	380 0	388 7
Final weight per calf	773.8	835.7	786.8
Total gain per calf	394.1	455.7	398 1
Average daily gain	1.88	2.17	1 90
Total feed consumed per calf:			
Ground barley	1499.1	....	....
Shelled corn	....	1339.9	1540.6
Whole oats	224.0	188.9	224.0
Linseed meal	....	283.8	....
Corn silage	2150.5	3032.5	2383.5
Alfalfa hay	958.0	1037.0	1034.0
Average daily ration:			
Ground barley	7.14	....	....
Shelled corn	....	6.38	7 34
Whole oats	1 07	.90	1 07
Linseed meal	....	1.35	....
Corn silage	10 24	14 44	11.35
Alfalfa hay	4 56	4 94	4 92
Feed per cwt. gain:			
Ground barley	380 4	....	....
Shelled corn	....	294.0	387 0
Whole oats	56.9	41.5	56 3
Linseed meal	....	62 3	....
Corn silage	545 6	665.5	598.7
Alfalfa hay	243 0	227 6	259.7
Feed cost per cwt. gain	$9 87	$10.23	$10.22
Pork credit per calf lbs	$10.27	$22.08	$19.43
Pork credit per calf at $9.00 per cwt	$0 92	$1.99	$1.74
Feed cost per cwt. gain (crediting pork)	$9 68	$9.79	$9.79
Initial cost in lots per cwt	$9.50	$9 50	$9.50
Initial cost in lots per calf	$36 07	$36 10	$36.93
Feed cost per calf	$38 89	$46 61	$40 70
Cost of calf plus feed cost	$74 96	$82 71	$77 63
Necessary selling price in lots to break even (crediting pork)	$9 57	$9 66	$9.64
Selling price in lots (Detroit price less 85 cents)	$10 65	$11.40	$10.90
Selling price per head in lots	$82 41	$95 27	$85 76
Returns per head above feed costs:			
Omitting pork	$7 45	$12.56	$8 14
Crediting pork	$8 38	$14.54	$9.88
Return per bushel ground barley or shelled corn	$0.99	$1.45	$1 20
Return per cwt. ground barley or shelled corn	$2 06	$2.58	$2 14

Prices of feeds:
Ground barley 72c per bu., shelled corn 84c per bu., oats 48c per bu., linseed meal $55 per ton, silage $5 per ton, alfalfa $16 per ton, pork credited at $9.00 per cwt.

fed calves went off feed very easily and were even more dull in their appetites than the corn fed calves, neither of which received linseed meal. Although practically the same gain in weight was made in each lot, the barley fed calves did not show so good a finish and were valued 25 cents per cwt. cheaper. Less feed was recovered by the pigs and in the end the return per calf above feed costs was $1.50 less than for the corn fed calves.

According to this trial, when fed with silage and alfalfa hay to fattening calves, ground barley is worth $1.40 per hundred pounds when the market price of shelled corn is $1.50 per hundred pounds.

LOG RULES OFTEN GIVE INACCURATE ESTIMATE

Woodlot Owners Suffer Loss on Timber Scaled With Rules in Common Use

BY J. C. DECAMP, FORESTRY SECTION

Standing timber is usually estimated in units of one thousand board feet (M. bd. ft.). Log rules give the content in board feet of any logs, where the length of log (L) and the diameter inside the bark (DIB) are known. There are many log rules and none of them agree exactly as to the content of any certain log. Some are based on diagrams, some on mathematical formulae, others on actual experience at sawmills, following the logs through and tallying the number of board feet actually secured. The amount of lumber which can be sawed out of a log varies considerably with the defects, the amount of taper, the market for small boards, the thickness of boards, thinness of saw, skill of the sawyer, and other factors. No one log rule is perfect, although some rules are more accurate than others for certain localities.

Log Rules Used by Timber Buyers

The Forestry Department of the State College this past year, endeavored to determine what log rules were being used in the purchase of farm woodlot timber in Michigan. Out of 35 representative purchasers of timber, 17 were using the Doyle rule, 4 were using the Scribner rule and 14 were using the Combined Doyle-Scribner rules. It will be of value to the owners of woodlot timber to know something of what these rules are, by which their timber is being measured.

The Doyle Rule is required by statute in Louisiana, Florida, and Arkansas. It is based on a mathematical formula and because of the fact that the formula assumes the same width of slab for a small log that it does for a large log, it gives ridiculously low content for the small log. It would come closer to actual log content if the smaller logs were measured at the center but the practice is to measure them at the small end. The Doyle Rule is very low for small logs, about right for logs 30 inches in diameter and slightly overruns on very large logs. The Doyle Rule is handy to use, in that one can obtain the content of a 16-foot log quickly by subtracting 4 from the log diameter and squaring the remainder.

The Scribner is the official Rule for Minnesota, Idaho, Oregon, Wisconsin, and West Virginia; also for the United States Forest Service. It is fairly accurate on small, sound logs and will underrun about 10 per cent in ordinary-size timber, such as we have in Michigan.

The Combined Doyle-Scribner is official with the National Hardwood Lumber Association. It uses the Doyle Rule so long as it gives smaller

values (up to 30-inch diameters) and then takes advantage of the underrun of the Scribner Rule. The Doyle-Scribner gives far too low a scale for the small sizes typical of Michigan woodlot timber and permits also the cutting down of scale in the large veneer logs, where most of the woodlot value lies.

Scale Measurement Compared to Actual Content

The attached diagram illustrates the difference between the log content as given by the Doyle and the Scribner Rules. Each column represents the scaled content of a 16-foot log, for a certain diameter, Scribner scale in black, while Doyle is cross-hatched. The full log content is represented by the Champlain Rule. It will be noted that the content increases very rapidly with increase in diameter. The small 6 and 8 inch logs are allowed hardly any scale at all. This is an argument in favor of leaving the small trees in the woods. It will also be noted that in an 8 inch log, the Doyle Rule gives only half the scale of the Scribner Rule.

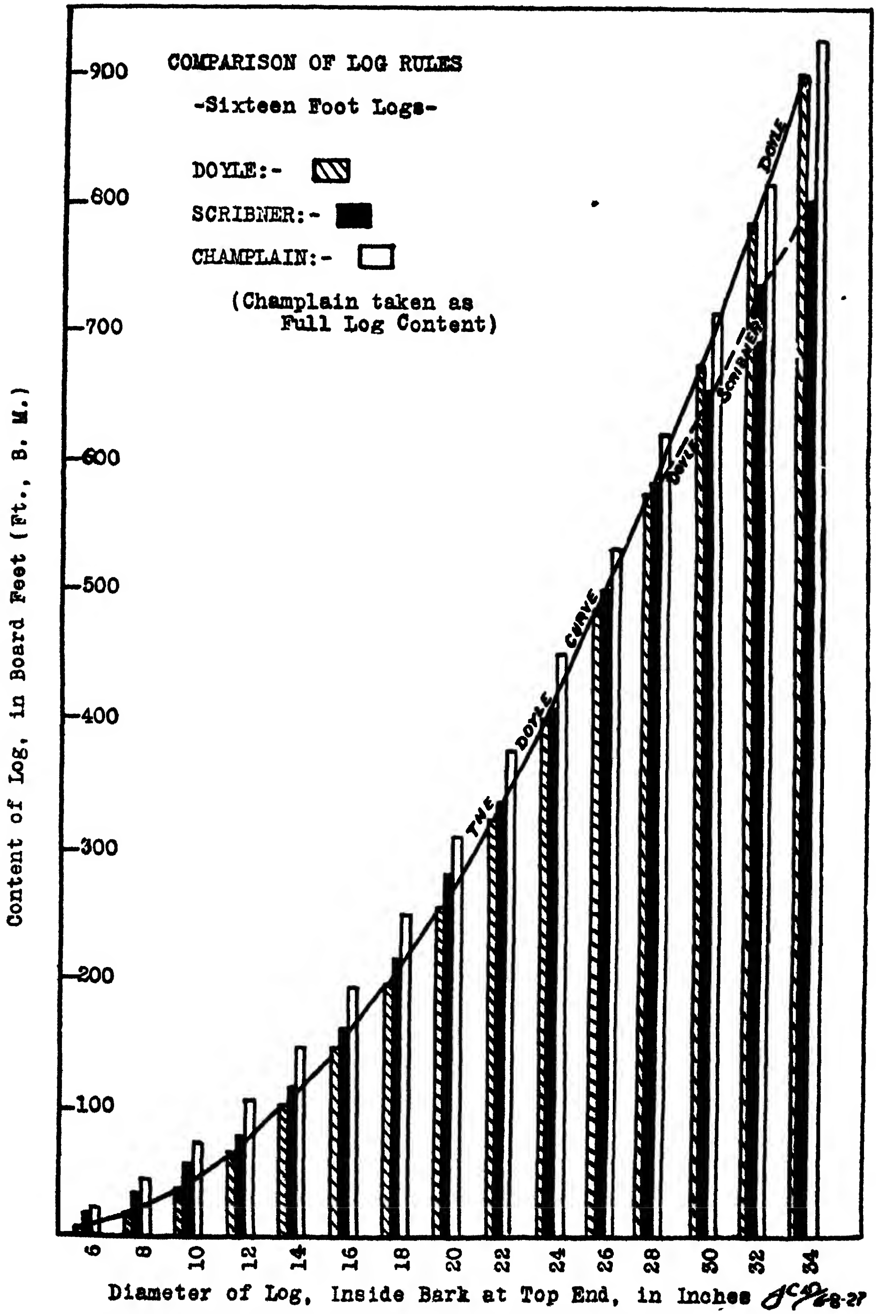
When one takes into consideration that the Michigan woodlot will only average 3 logs to the tree and that the top log will be an 8-inch log, one begins to realize the importance of selling one's timber by the Scribner rather than by the Doyle Rule. Reference to the diagram will show further that the Doyle Rule which gives only about one-third the actual content of an 8-in log, keeps on increasing its proportion of the full content until at 34 inches, its scale approximates nearly the total of board feet that can be sawed out. But before this time, however, between 28 and 30 inches, the Doyle-Scribner branches off from the Doyle curve and follows the lesser values for large logs as given by the Scribner.

Comparison of Measurements With Different Rules

One way to compare the Doyle and Scribner Rules is to follow the log through the mill, tallying the boards as they are sawed out. The author of this article, assisted by some of the Forestry students, made one such study in 1924 in a small mill in the north-central part of the State. Three hundred thirteen logs went through this mill in 10 hours. These logs were exceptionally good quality, cull under 5 per cent, and averaging 10 to the M. ft. BM.; average diameter, 14 inches. They were 93 per cent maple, with comparatively little taper. Net log scale by the Doyle Rule was 29,028 bd. ft.; by the Scribner Rule it was 34,374. The mill tally showed 33,862 ft. (59 per cent in 1-inch boards). The Doyle Rule ran 18 per cent under the Scribner and 17 per cent under actual log content as sawed out. The mill would have shown a bigger lumber tally, had it not been putting some of the poorer grade stuff into distillate and fuel wood (35 cords in 10 hours). The scale would have shown a greater discrepancy between the Doyle and Scribner Rules, had the logs been smaller and contained more beech and hemlock in place of the maple.

Rules Underestimate Timber on Tract

It is evident that the poorer the woodlot timber, the greater will be the difference between the Doyle and Scribner scale. The author had occasion to cruise one tract of timber in the southern part of the State, in which there was an exceptionally fine stand of beech, with very little taper. A



Graph shows variation in measurements obtained through use of different Log Rules.

double estimate was carried, one for Scribner scale, using volume tables; the other for Doyle scale, based on stump diameter and taper curves. It was found that Doyle under-ran Scribner, as follows: Beech (exceptionally little taper), 22 per cent; basswood, 28 per cent; maple (small and stubby), 43 per cent; elm, 32 per cent: Average, all species, 24 per cent. This particular woodlot averaged 19 M. ft. per acre, Scribner scale, valued at $20.00 per M. To have sold it by the Doyle scale at the same price per M., would have meant a loss to the farmer of four and one-half M., or $90 per acre.

Timber Owner Loses on Doyle Measurement

The use of the Doyle rule in scaling long timbers (piling) is indefensible. Mill tests in sawing up 24 feet piling have shown the mill scale over-runs the Doyle scale, from 483 per cent on 6-inch tops to 51 per cent on 12-inch tops. The woodlot owner cannot afford to sell his timber by the Doyle scale. He should insist where possible on the Scribner, although even the Scribner does not give him full justice on the smaller logs.

ECONOMIC WINTER RATIONS FOR FARM WORK HORSES WINTER 1926-1927

Winter Alfalfa Pasture and Roughage Reduces Feed Costs to Low Figure

R. S. HUDSON, FARM AND HORSE DEPT.

This work is a continuation of the work of the winter of 1925 and 1926 but differs in that carrots and silage were not used as a part of the ration. The results of the previous years test seemed to indicate that the horses were getting plenty of succulence through the alfalfa winter pasture and that these materials added only to the cost of the ration. The horses were not divided into two separate lots as in the 1925-26 test, the idea being that accurate comparisons could not be made when the animals were getting an unknown quantity of their ration from the alfalfa fields and also that some of the animals were for sale and liable to be disposed of at any time. As a matter of fact, four out of the ten horses were sold February 14, which indicated that the slight losses they experienced in weight due to the cheap ration being consumed did not prevent them moving at a good price.

All animals were weighed three times daily for three days and the average taken as the weight of the animals for the beginning and closing of the report.

For convenience the animals sold are reported in Table I and the others in Table II.

TABLE I

Name	Age	Weight		Feed consumed		Selling price
		Dec. 19 1926	Feb. 13	Shredded fodder	Alfalfa	
Jasper	5	1726.6	1676 6	391	448	$225 00
Dexter	5	1851.1	1784.4	374	448	225.00
Maud	7	1706.6	1606.8	221	448	200 00
Margorine	7	1787 7	1684 4	290	448	200.00
Total	....	7072 0	6756.2	1276	1792	....

Four horses consumed 1,792 pounds alfalfa hay and 1,276 pounds shredded corn fodder in 56 days, or an average of 8 pounds alfalfa and 5.69 pounds shredded fodder daily, costing 8.3c.*

TABLE II

Name	Age	Weight		Feed consumed		
		Dec. 19 1926	Mar. 20	Shredded fodder	Alfalfa	Corn
Arlie....	19	1561 1	1447.7	328	728	132
Tom......	10	1486 6	1416 7	452	728	132
Dick..	4	1360 7	1352.2	606	728	132
Topsy	5	1408 8	1344.4	525	728	132
Lightning....	12	1484.4	1470 0	542	728	259
Thunder....	13	1568 8	1591.1	500	728	259
Total..	....	8870 4	8622 1	2953	4368	•

Six horses consumed 4,368 pounds of alfalfa hay and 2,953 pounds of shredded corn fodder in 91 days or an average of 8 pounds alfalfa and 5.4 pounds shredded fodder daily costing 8.2c.

Cost Basis

Alfalfa hay $16.00 per ton.
Shredded corn fodder $7.00 per ton.
Ear corn on shelled corn basis of 84c.

Gain or Loss in Weight

Four horses weighed 7,072.0 pounds at beginning (Dec. 19) and on February 13, 56 days after, weighed 6,756.2, a loss in weight of 315.8 pounds or 1.41 pounds per head daily.

Six horses weighed 8,870.4 pounds December 19 and 8,622.1 pounds March 20, or a loss in weight of 248.3 pounds or .455 pound per head daily.

Conclusions

1. Horses may be wintered on rations costing as low as 8.2 cents per day.
2. Slight losses in body weight do not prevent them doing a good springs' work, providing grain becomes a part of the ration.
3. Moderate feeding with plenty of outdoor exercise seems to contribute toward less difficulty with sore necks and shoulders.
4. Where alfalfa meadows are available, the late fall growth may be utilized by horses, without damaging the seeding and greatly reducing the cost of wintering the animals.

*On February 14, the two horses, Thunder and Lightning, were given 6 pounds daily of ear corn in addition to the regular ration of alfalfa and fodder. These two horses were somewhat thin in flesh at the beginning December 19 and the addition of corn to the ration seemed advisable for putting them in better shape for spring's work. The four other animals were given six pounds of corn on March 1 and on March 15 all six of the horses were increased to eight pounds of ear corn daily. The addition of six pounds of corn increased the cost of the ration to 17.2c daily. The addition of eight pounds of ear corn daily increased the cost of the ration to 20.2c daily.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experiment State, East Lansing, Michigan.

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251 Insects of 1907.
258 Insects of Field Crops.
262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
273 Utilization of Muck Lands.
277 Studies in the Cost of Market Milk Production.
281 Trees, Shrubs and Plants for Farm and Home Planting.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. 10, No. 2, November, 1927

O. A. C. NO. 104 WHEAT YIELDS WELL IN TRIALS

White Wheat Meets Demand of Millers for Variety of Low Protein Content

E. E. DOWN AND H. M. BROWN, FARM CROPS SECTION

Considerable demand has been made by Michigan millers and wheat growers for the development of a higher yielding, winter-hardy, white wheat of low to medium protein content. A great many selections and several crosses have been made in attempting to obtain such a wheat. The breeding of a new variety is a long-time project, the first step being the testing as to yield and quality of all known worthwhile varieties.

While testing white wheats from different sources, we found that O. A. C. No. 104, a beardless white wheat developed at the Ontario Agricultural College, Guelph, Ontario, Canada, produces more grain to the acre, is but slightly higher in protein content, and is possibly more winter-hardy than American Banner, the white wheat commonly grown in this State and the only white wheat being inspected by the Michigan Crop Improvement Association.

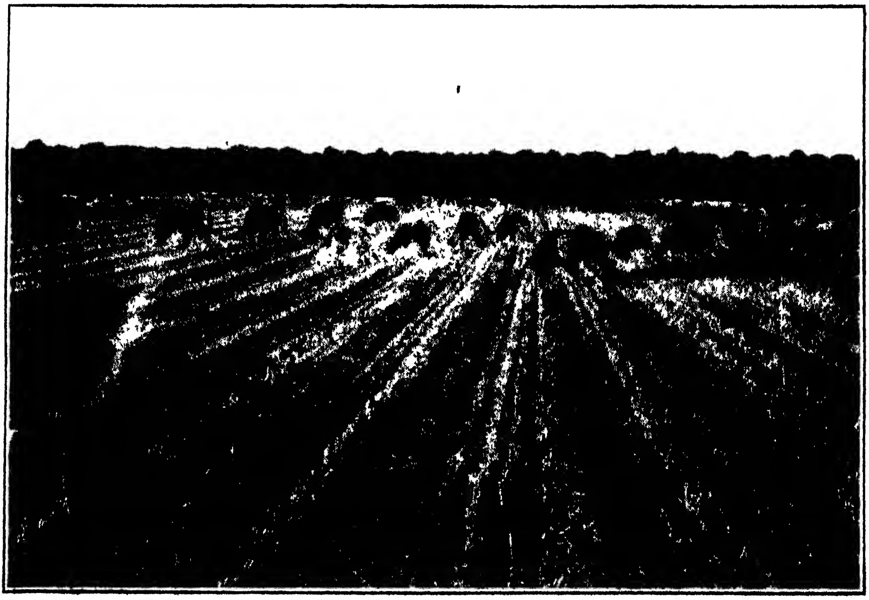
Outyields Other Varieties

The comparative yields of O. A. C. No. 104 and American Banner, for the years 1925, 1926, and 1927 are given in the accompanying table, and there will be found the number of plots planted to each variety and the yields, in bushels per acre, for the yearly averages of those plots and for the averages of the three ye[illegible].

[illegible]	1925	1926	1927	Average for the 3 yrs.
Number of plots	4	4	2	
Variety name	Yield in bushels per acre			
O. A. C. No. 104	36 1	35.4	39.3	36 9
American Banner	28 1	30 0	35.8	31 3

The average results for each year show O. A. C. No. 104 to be consistantly better in yield than American Banner. However, the individual

General view of the increase plot of O. A. C. No. 104 wheat in 1927



General view of a portion of the variety series of 1927. Plots are four drill-hoes wide and approximately 400 feet long.

results (yields not given) obtained from each of the 10 plots grown during the three years are even more convincing for in every case O. A. C. No. 104 led by a good margin.

Forty-eight bushels of this wheat were distributed during the first part of September, 1927, to nine able seed wheat growers located in widely separated regions of the Michigan winter wheat section. These fields will be inspected by the Michigan Crop Improvement Association and the grain from those fields which pass inspection will be offered for general sale in the summer of 1928.

OPERATING THE ENSILAGE CUTTER WITH ELECTRIC MOTOR

Power Costs at Minimum, Enables Reduction in Men for Silo Filling Crew

O. E. ROBEY,* AGRICULTURAL ENGINEERING SECTION

The problems of rural electrification are largely ones of adapting known electrical appliances to farm conditions. This fall a study was made of the practicability of using a small electric motor to operate an ensilage cutter.

The ordinary method of ensilage cutting necessitates the employment of a large crew to operate the usual large-size, tractor-powered cutter. At first it did not seem feasible to use an electric motor for this purpose because a rural power line will usually not permit of the use of a motor of more than five to eight horsepower, and, also, in most cases, it would not be practical to purchase a large motor for operating the ensilage cutter when a tractor is already available.

The problem then seemed to be to select a small ensilage cutter and see if it could be satisfactorily operated with a small motor which would be suitable for other jobs on the farm.

Cutter Operator Controls Motor

An eleven-inch ensilage cutter was selected. This was belted directly to a five horsepower single phase electric motor mounted on the frame of the cutter. The method of connecting this up is shown in Figure 1. The motor can be stopped or started by a push button at the feed table, and is provided with a special overload release which stops the motor if a continuous overload is applied.

The outfit was assembled at the College and used in filling four silos on the Mason-Dansville Experimental Line. The silos ranged in height from

*Assisted by E. C. Sauve, Agricultural Engineering Dept.

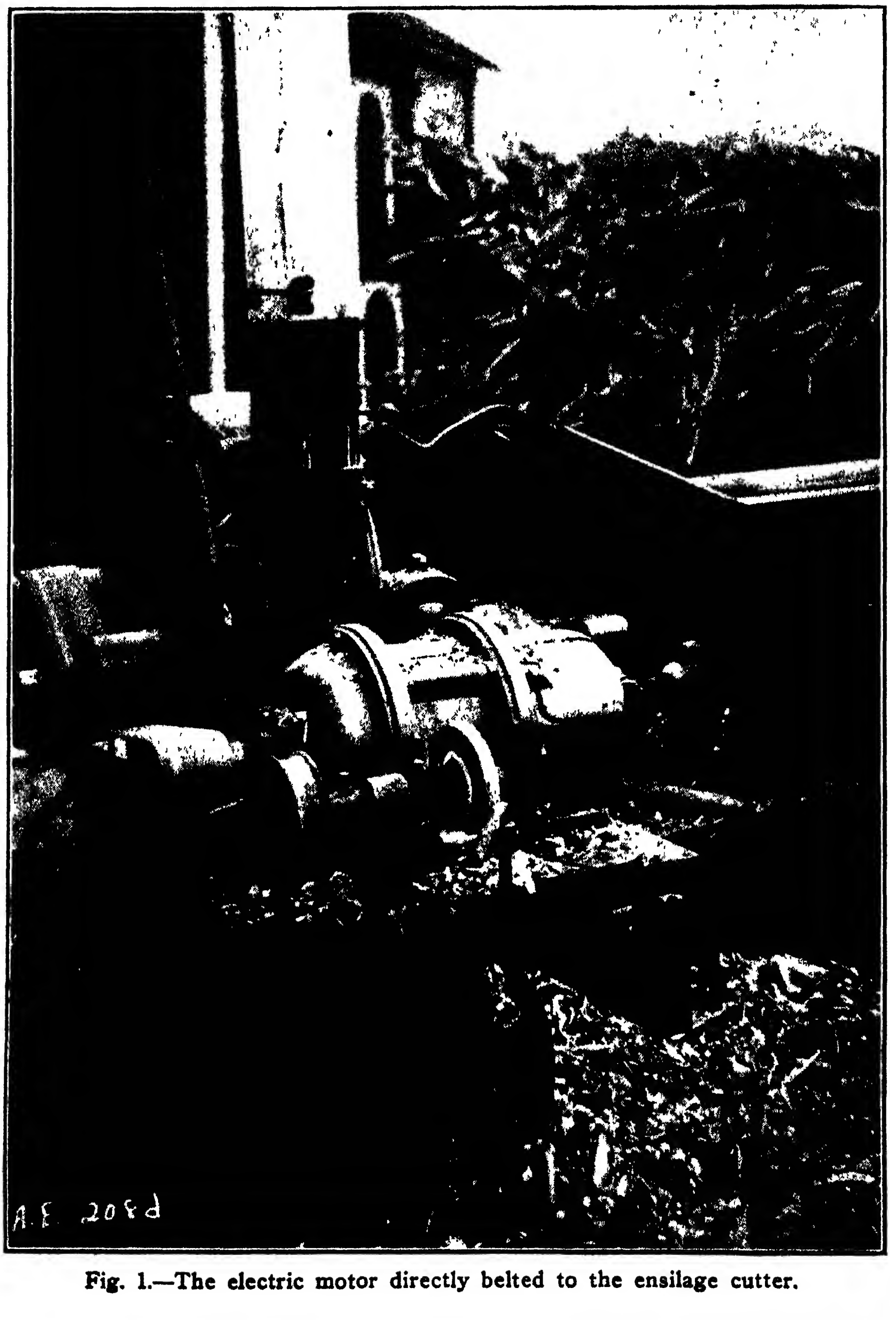


Fig. 1.—The electric motor directly belted to the ensilage cutter.

28 to 40 feet and from 50 to 100 tons capacity. The following table gives the data collected regarding costs and time required.

Factors considered	Silos No. 1	No. 2	No. 3	No. 4
Height of silo	37	40	28	32
Diameter of silo	10	12	10	10
No. of men in crew	2	7	6	6
Average distance of haul in rods	100	100	80	20
No. tons of ensilage cut	53	65	30	40
Time required for filling in hours	18	15	3¾	8
Average tons per hour	*5 9	4 3	8	5
Man hours per silo	36	103	22½	48
Team hours per silo	36	51½	11¼	16
Power consumed per silo K. W. H	66	53	18	41
Costs				
Current at 3c per K. W. H.	$1 98	$1 59	$0 54	$1 23
Man labor at 40c per hr.	14 40	40 20	8 80	19 20
Teams at 30c per hour	10 80	15 35	3 37	4 80
Interest and depreciation	7 05	7 05	7 05	7 05
Total	$34 23	$64 19	$19 76	$32 28
Cost per ton	$0 65	$0 99	$0 66	$0 81

*Machine only running half time.

Profiting by the experiences of some other stations, the ensilage cutter was run at much lower than the rated speed. The best speed was found to be from 525 to 550 revolutions per minute. At this speed the machine seemed to have as much capacity as at the higher speeds and was less likely to clog.

Power Costs Low

One of the most startling results of the experiment was the small amount of current consumed. As indicated in the table one silo was filled at a cost of only 54 cents for electricity while the most expensive was only $1.98.

This method of filling lends itself to the use of a small crew at filling time. One farmer (Silo No. 1) filled his silo with only one man besides hmiself and two teams. Two wagons were taken to the field and loaded, they were then brought to the barn, one man unloading while the other tramped the silage in the silo.

One of the things that was commented on favorably by the farmers operating the outfit was its convenience. No cranking or other gas engine troubles interfered and no stalking or bracing of the machine was necessary.

While the results of this test may not be conclusive, and more work should be done in testing other types of machines, the results so far seem to indicate great possibilities in the use of the small motor for operating the ensilage cutter.

PROPER ROTATIONS LIMIT WHITE GRUB DAMAGE

Another Infestation Due in 1930 in Sections Suffering Loss This Year

R. H. PETTIT, ENTOMOLOGICAL SECTION

The summer of 1926 witnessed the presence of large numbers of common June bugs in Michigan. Following this outbreak, as was to be expected, during the summer of 1927 the common white grub was very plentiful and caused considerable loss, the grubs working underground, eating the roots from such crops as corn and grasses and tunneling in the tubers of potatoes and similar plants.

Insect Appears In Cycles

The common June bug, which in one stage of its development appears as the white grub, has a three-year cycle. Therefore, we may confidently expect that during 1929 the beetles will again be plentiful and that in 1930 the farmers of the State will be called on to endure another attack by white grubs. This infestation of white grubs is not evenly distributed over the state. In some portions the grubs are plentiful this year and in others only a few are to be found. The area involved may, of course, change somewhat owing to the dying out of the pests in some districts and their spread into other districts. However, in general it is safe to assume that the area involved during 1930, will coincide roughly with that of 1927.

Natural Control Insufficient

Many forces are at work to kill off the June beetles but they never seem to be able to bring about a complete control. It is therefore urged on the farmer to take note as to the condition of his fields this year and, if white grubs have been eating the roots from his crops, to bear in mind that the situation is likely to recur 1930.

The beetles lay their eggs in grass sod for the most part. Strawberry patches seem to be favorite places as well, and, this year, we have reason to believe that bean fields are also often selected by the beetles. At any rate, it will be well in districts where the June beetles are present to avoid the raising of corn, potatoes, or any other crop particularly loved by the white grubs if such land happens to be in grass sod or beans during 1929. The writer would welcome any records of white grub injury which has occurred during the summer just ending, in order that the area may be plotted on a map so that this warning may be repeated during 1929.

Sprays Sometimes Help

In ordinary farm operations one can sometimes forestall serious losses by so arranging his rotation that the grubs work at a disadvantage. How-

ever, the grubs often work in golf links and in lawns and similar places where rotation is out of the question. In such cases it is possible to secure quite satisfactory results by spraying the trees in the vicinity with arsenate of lead on the year preceding the attack by the grubs. It happens that the beetles dearly love shade trees and are particularly fond of oaks. The destruction of beetles, of course, does away with the attack by the white grubs during the following season.

A FARM MANAGEMENT STUDY IN THE CORN BORER AREA

Changes In Farming Practice and Farm Organization in Southeastern Michigan Due to the European Corn Borer

E. B. HILL,* R. V. GUNN* AND GEORGE W. COLLIER†

A new element has been introduced into the problem of farm management in the southeastern quarter of the state through the spread of the European Corn Borer in Michigan since 1921. Commercial damage by the borer has been limited, however, to a few rather small areas. Nevertheless, the adoption of cultural measures necessary to keep the corn borer infestation under control calls for such a change in the farming practices in some areas as to create a new problem of considerable importance. For example the fact that most farmers in the southeastern portion of the state found it necessary to use additional horse and tractor power and almost twice as much man labor as are ordinarily used in preparing their 1926 corn fields for spring crops in 1927 naturally raises two important farm management questions. (1) The most economical methods by which an effective clean-up may be obtained and (2) the effect of the borer in these areas upon farm income, land values, size of farm and related problems.

In making this study 250 farmers were visited in four areas in southeastern Michigan; Ridgeway township in Lenawee county, Raisinville Township in Monroe, Howell in Livingston, and China township in St. Clair county. These areas were considered to be fairly typical of different parts of the region. In short, Lenawee was selected because of its importance as a corn-producing area; Monroe because of its longer experience with the corn borer; St. Clair because it was representative of the heavier, corn borer infested areas of the State; and Livingston because it was representative of a large group of Central Michigan counties on the margin of the quarantine area.

Types of Farming in the Four Areas

The agriculture in each of the four areas studied had certain variations which distinguished one region from another. An idea of the number and

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†The Bureau of Agricultural Economics, United States Department of Agriculture.

kinds of livestock and acres of crops per farm may be obtained from Tables 1 and 2. Lenawee had fewer dairy cows but more corn, wheat, hogs, and hens than any of the other regions. Considerable cattle and sheep feeding is done in this area. Monroe had a few more cows, nearly as much corn, and less of wheat, hogs, and hens than Lenawee. Livingston had more dairy cows and sheep but fewer hogs and hens and a smaller acreage of corn and wheat than either Lenawee or Livingston. The St. Clair area had the same number dairy cows per farm, and a smaller acreage of corn and oats than Livingston county, but there were practically no hogs or sheep.

Table 1.—The average number of livestock per farm visited and per cent of farmers owning tractors and silos in each of the four townships, August, 1927.

	Ridgeway Lenawee County	Raisinville, Monroe County	Howell, Livingston County	China, St. Clair County
No. of farms visited	76	58	51	66
Acres per farm	120	125	147	97
Dairy cows	5	7	8	8
Brood sows	5	3	2	.....
Pigs raised per year	59	32	11	2
Sheep, ewes kept	....	....	28	....
Hens	158	142	85	138
Horses	3 6	4 3	3 5	2.5
Tractors, percent of farmers owning	58	34	30	40
Silos, per cent of farmers owning	33	59	60	42

Table 2.—Distribution of crop area by districts with changes in the acreage of various crops between 1926 and 1927.

		Lenawee	Monroe	Livingston	St. Clair
No. of farms visited		76	58	51	66
Acres per farm		120	125	147	97
Corn	1926	30	24	18	10
	1927	23	24	15	7
	*1928	21	22	16	5
Wheat	1926	22	18	13	12
	1927	24	16	12	11
Oats	1926	18	20	17	12
	1927	19	20	16	13
Barley	1926	5	1	.....	....
	1927	7	2	2	1
Alfalfa	1926	8	6	7	1
	1927	9	7	8	2
Beans	1926	....	....	5	....
Mixed hay	1926	6	14	22	21
	1927	7	15	20	21
Other crops	1926	2	3	7	1
	1927	2	3	8	2
Pasture	1926	22	31	59	35
Percent of land in harvested crops		76	69	57	59
Percent of crop land in corn		33	28	21	17
Percent reduction in corn acerage 1926-1927		23.5	1	14	23.5
Additional contemplated reduction in 1928		7.9	7	....	26 8
Percent of farmers reducing corn acreage on account of borer		49	7	20	58

*Acreage of corn which the farmers stated they planned to plant in 1928.

Changes in Acreages in Crops, 1926 and 1927

There was a 23.5 per cent reduction in the acreage of corn from 1926 to 1927 in the Lenawee and in the St. Clair areas as shown in Table 2. There was a 14 per cent reduction in Livingston. Much encouragement, however, is to be obtained from the Monroe area where there was practically no reduction in the corn acreage from 1926 to 1927. There is some evidence that when the farmers have had time to study their readjustment problem it will be found that a portion of the reduction of corn acreage in these areas was of a temporary nature and that some of them may return to more nearly their normal corn acreage in 1928.

It is evident that, on the average, less difficulty will be experienced in performing clean-up work in the future than was the case last year. Growers were not acquainted with the regulations until it was quite late to modify their plans. Furthermore, many farmers did not know or understand the most economical methods for an effective clean up of the stubble or stalks. With the experience of 1927 as a guide and with more time in which to plan farm operations so that more work can be done in the fall, it should be easier to meet clean-up requirements in the future than it was this year.

Time Required in 1927 Clean-Up

The amount of additional labor required to make a satisfactory clean-up of the 1926 corn fields to meet the clean-up requirements depended on many factors, for example (1), the kind of machinery used and the skill exercised in its operation; (2), the acreage of corn per farm; (3), whether the corn was husked, snapped, or pastured off; (4), whether plowing or disking for spring grains is the usual practice; (5), soil conditions; (6), amount of rainfall in the spring.

Where there was a large acreage of corn especially on the larger farms, it was very difficult to find time to do the necessary handpicking of corn stalks and stubble without delaying other farm work or hiring considerable labor. The work of preparing corn land for spring grains in localities where they are usually disked in was more than doubled by the necessary plowing, extra fitting, and hand picking, (see Table 5). Most of the disking instead of plowing for spring grains was done in Lenawee and St. Clair counties. The wet weather combined with a heavy and usually poorly drained soil made the clean-up especially difficult in the St. Clair area.

Handpicking was the most important single item involving additional labor in the clean-up program. A large number of farmers reported extra time for plowing, either for the entire operation or for slowing up in an attempt to do a better job. Cleaning up around the barns and lots was the next most important item. Other operations requiring additional labor were breaking stalks with T-rail or a plank, raking stalks, stubble beating, and in some instances disking, rolling, and dragging.

The average amount of additional man, horse, and tractor labor to prepare 10 acres of corn land for spring crops in each of the four areas is shown in Table 4. By placing a value of 30c an hour for man labor, 15c an hour for horse labor, and $1.00 an hour for tractor labor, an idea of the value of the additional labor may be obtained. In most cases, however, the additional labor was performed by the farmer, his

family, and regular farm help without hiring any more labor for this purpose. In Lenawee, 18 per cent of the additional labor was performed by labor especially for that purpose. In the Monroe area 11 farmers out of 58 hired extra labor. In the Howell area four farmers out of 51, and in St. Clair three farmers out of 66 hired extra labor to aid in the clean-up.

Table 4.—Average amount of extra labor to prepare 10 acres of corn land for spring crops in the different areas, including barn and lot clean-up.

	Ridgeway Twp., Lenawee County	Raisinville Twp., Monroe Co'. ty	Howell Twp., Livingston County	China Twp., St. Clair County
Man labor, hours	56 6	55 2	63 3	72.4
Horse work, hours	51 9	40 4	43 2	33 1
Tractor, hours	7 9	2 3	2 4	6 3

The average amount of hand picking and burning per acre in the different areas was as follows: Lenawee, 2.2 hours; Monroe, 3.2 hours; Livingston, 3.7 hours; and in St. Clair, 5.1 hours. There was also a great variation in these figures on different farms in the same area depending on the thoroughness of the job, kind of machinery used in preparing the soil, and the skill exercised in the operation of the machinery.

Table 5.—Typical labor and power requirements per acre for preparing corn land for spring crops under normal condition as compared to conditions under control methods.

	Normal operations			Operations under control methods			Difference in requirements per acre		
	Man hrs.	Horse hrs.	Tractor hrs	Man hrs.	Horse hrs.	Tractor hrs.	Man hrs.	Horse hrs	Tractor hrs.
Farms where plowing with horses for spring grain is the usual practice:									
Lenawee	8 3	23 1	....	11 7	27 5	.	3 4	4 4	....
Monroe	9 0	24 6	.	14 1	30 1		5 1	5 5	.
Livingston	8 6	23 0	..	14 3	27 7		5 7	4 7	.
St. Clair	10 0	21 4		16 4	25 2	..	6 4	3 8	......
Farms where disking with horses for spring grains is the usual practice:									
Lenawee	5 2	13 8	...	13 3	31 5	...	8 1	17 7	...
St. Clair	4 8	12 4	.....	16 4	25 2	......	11.6	12 8	....
Farms where plowing with tractor for spring grains is the usual practice:									
Lenawee	5 9	10 8	1 7	8 5	9 8	2 7	2 6	-1 0	1.0
Livingston	6 2	11.0	1 6	11.3	12.7	2 0	5 1	1 7	.4
St. Clair	5.7	6 2	2 6	11 6	8 6	2 8	5 9	2 4	.2
Farms where disking with tractor for spring grains is the usual practice:									
Lenawee	3 8	5 4	1 4	9 4	9 6	3.4	5 6	4 2	2.0
St. Clair	3.4	4 0	1 4	11.6	8 6	2.8	8.2	4 6	1.4

The total amounts of labor and power requirements per acre for preparing corn land for spring crops under normal conditions as compared to conditions under control methods are shown in Table 5.

This table has been prepared on the basis of four different conditions representing the main situation found in southeastern Michigan, (1 and 2) where plowing with horses or tractor for spring grains is the usual practice, (3 and 4) where disking with horses or tractors for spring grains is the usual practice.

As in Table 4, by allowing 30c, 15c, and $1.00 an hour respectively for man, horse, and tractor labor, a value for the additional labor under the different conditions may be obtained.

Crop Adjustments

The main regions where other crops were being substituted for corn were in Lenawee and in St. Clair. The extent of this substitution and the crops substituted are shown in Table 2. In general, the choices of Lenawee county farmers of crops to substitute for corn are barley, wheat, oats, sugar beets, alfalfa, and sweet clover, in the order named. In St. Clair, the choices are barley, wheat, oats, alfalfa, mixed hay, sweet clover, sugar beets and buckwheat, in the order named.

In most cases, however, with the possible exception of some parts of the St. Clair area, farmers are not justified in substituting other crops for corn until the yields of corn are reduced to such an extent that less feed or cash returns are obtained per acre than can be obtained from the substitute crops, unless the farmers prefer the lower return to the extra labor, especially the extra hand labor which accompanies corn production under corn borer conditions.

Farmers who are interested in studying the complete reports of the study in any of these areas may obtain a copy upon request to Director R. S. Shaw, East Lansing, Michigan.

A copy of the corn borer regulations may be obtained upon request to A. C. Carton, Bureau of Agricultural Industry, State Department of Agriculture, New State Building, Lansing, Michigan.

Information as to methods of control for the European Corn Borer is contained in Extension Circulars Nos. 55 and 59 which may be obtained upon request to R. J. Baldwin, Director, East Lansing, Michigan.

THREE NEW EARLY GRAPES SHOW PROMISE IN STATE

Characteristic Early Ripening May Extend Limits of Grape Area Northward

H. M. WELLS, HORTICULTURAL SECTION

The northern limit of grape culture in Michigan is set by the length of the growing season and by summer and fall temperatures. The Concord variety does not ripen satisfactorily very far north of Grand Rapids, unless the season or the location is particularly favorable, and, some years, the quality of its fruit is not all that might be desired even in the latitude of Grand Rapids. Earlier maturing varieties such as Moore Early, Campbell Early, and Diamond may be grown a little farther north than Concord, but they too develop mediocre quality if the maturing season is cool.

Many Varieties Tested

During the last few years there have been under test at the Graham Horticultural Experiment Station at Grand Rapids a number of new grape varieties that appeared to be worthy of trial from the standpoint of early maturity and a short growing season. Three of these varieties, originated by the New York Agricultural Experiment Station, appear so promising that brief descriptions and recommendations for more extended trial seem in place.

Ontario.—The vine of the Ontario is vigorous, productive, and apparently hardy. It produces medium to above medium, attractive bunches that are often single shouldered, though they are only medium compact or perhaps inclined to be a little loose. The berries are large and attractive, light green in color, tinged with amber where exposed to the sunlight. The skin is medium tender and separates readily from the pulp. The flavor is sweet but sprightly; the quality is very good. At the Graham Experiment Station, the ripening season of this variety has been August 10-15, from four to six weeks ahead of that of Concord.

Portland.—The vine of the Portland is vigorous, productive, and apparently hardy. Its bunches are medium or above in size, are compact, and compare favorably with those of Niagara. The berries are green in color, medium or above medium in size and do not shell badly. The flavor is moderately sweet and the quality good but not the equal of that of the Ontario. In our experimental plots near Grand Rapids, it ripens along with Ontario, four to six weeks ahead of Concord.

Grieg.—The vines of Grieg, like those of Ontario and Portland, are vigorous, productive and apparently hardy. The bunches are rather small and short but, nevertheless, compact and attractive. The berries

Fig. 1.—A cluster of Greig grapes, an extra early blue variety. Slightly reduced.

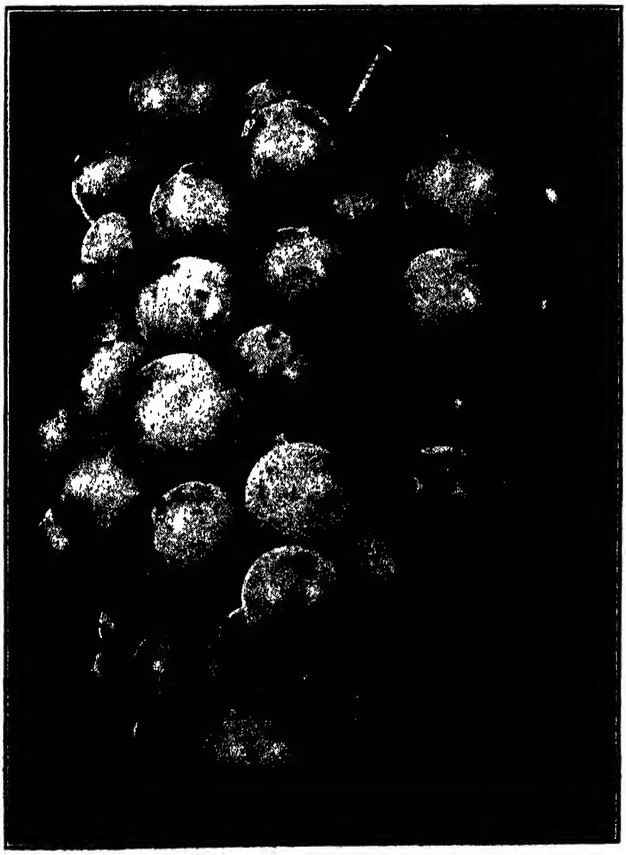


Fig. 2.—A cluster of Ontario grapes, an extra early white variety. Slightly reduced.

are of medium size, black, and covered with a heavy blue bloom. The skin separates readily from the pulp. The juice is sweet and the quality good to very good. In season, this variety is three to four weeks ahead of Concord, maturing a little ahead of Moore Early.

Recommendations

The limited trials that have been made with these three grape varieties do not warrant recommending them for extended commercial culture. Their high quality, however, coupled with their early maturity indicates that they are likely to prove valuable in the home vineyard and for local markets along the present northern edge of grape culture in this state. Indeed they should be tried for home use as far north as Manistee or Traverse City, especially if set on southern exposures or in protected situations and in comparatively frost-free places. Furthermore they should be tried in a limited commercial way in some of the more favored portions of the state, for sale on roadside stands and other local markets, as they give promise of materially lengthening the grape harvesting season.

ONION AND BULB CROPS' PEST APPEARS IN STATE

Lesser Bulb Fly, Eumerus strigatus, Shows Preference for Hyacinth Bulbs

EUGENIA MC DANIEL, ENTOMOLOGICAL SECTION

The cold, wet weather which prevailed during the Spring of 1927 furnished ideal conditions for the development of root maggots which were consequently more plentiful than ordinarily. In addition to the old, established, well known maggots infesting beans, corn, cabbage, and onions, a new species, the lesser bulb-fly, made known its presence in the state for the first time this year.

The arrival of this new species is not only important from the bulb grower's standpoint, but the creature is also known to be a serious enemy to the common onion. Its advent was expected, since it had already been reported from practically all of the bulb-growing districts of the world.

Plants Attacked

The narcissus bulb seems to be its first choice as a breeding ground, although it will breed in hyacinth, onion, potato, parsnip, and in iris roots. It has been reared in great numbers from iris roots which were suffering from an attack of the "Iris borer," Macronoctus onusta. Roots injured by the Iris borer begin to break down and seem to be espe-

cially attractive to the lesser bulb-fly. The fly seems to prefer weakened or diseased bulbs, although very young larvae are capable of establishing themselves in healthy bulbs.*

There are two generations and a partial third each year. The winter is spent in the larval stage, and pupation takes place in the early spring. The adults appear in May or early June and deposit eggs for the next generation. The second generation appears in about six weeks though all do not mature at the same time even where conditions of temperature, moisture, and food supply remain uniform. Some larvae do not mature until the spring of the following year. This is one of the provisions of nature to protect the species from extinction. The adults of the first generation appear in May or June, those of the second generation in July or August, and the third generation appears in September. The broods are not definite since stragglers are emerging all through the summer but there are certain times when the adults are more plentiful than at others.

Appearance of Insect

The mature insect is a fly about the size of a common house fly. It is black in color reflecting a metallic bronzy sheen when examined in the sunshine. The wings, when at rest, are folded flat over the back, giving the insect a wasp-like appearance. The abdomen is marked with three pairs of crescentric, plumose white bands.

As is typical of the family Syrphidae, to which this fly belongs, the adults are active on bright warm days, hovering above their food plants or over a bulb field. They do not venture into the shadows even when such places afford ideal breeding quarters.

Fig. 1.—Adult of Lesser Bulb-fly enlarged about three times.

*Hodson, W. E. H.—Bul. Ent. Res., Vol. XVII, Pt. 4, p. 378, 1927.

The adults live for three or four weeks, and each female produces about a hundred eggs in a lifetime. These eggs are laid at different times either singly or in clusters on the foliage, the bulb itself, or on the soil. When infested bulbs are planted, their growth is dwarfed, the foliage turns yellow, and breaks off before the normal plants have matured.

Detecting Infected Bulbs

Infested bulbs can be detected by the peculiar "give" which is noticeable when the bulb is squeezed between the thumb and finger. Where the bulb is healthy and only a few larvae are present, this method may not always work. Where the infestation is heavy, there is usually no question about detecting them. The larvae measure over a quarter of an inch in length and there may be from fifty to several hundred in an average sized bulb. The interior of a bulb infested to this extent is of course reduced to a putrid mass. Such bulbs should either be destroyed by fire or buried in a deep pit, since recovery is out of the question.

Larvae thrive where conditions are warm and moist. When the food supply is cut down, they either die or small undersized individuals appear. Experiments* have shown that the larvae are not capable of migrating from one bulb to another.

Fig. 2.—Larvae of Lesser Bulb-fly enlarged about three and one-half times.

The pupal stage on the other hand is passed in dryer quarters, the larvae, when nearly ready to pupate, migrating from the infested bulb out into the soil for several inches. This migration into the soil usually takes place in the spring, since the mid-summer generations either pupate up on the foliage or about the bulb-neck.

Control

There seems to be no single treatment or practice that will give a hundred per cent control.

*Hodson, W. E. H.—Bul. Ent. Res., Vol. XVII, Pt. 4, p. 380, 1927.

The standard remedial measures recommended by the United States Federal Horticultural board are the hot water treatment, and fumigation with carbon disulphide under pressure.

Fortunately this maggot also responds to the corrosive sublimate treatment. If this treatment is used, the following directions should be followed carefully.

Dissolve one ounce of corrosive sublimate in eight gallons of water, using a wooden or earthen-ware container. The crystals may be dissolved in a small amount of hot water and stirred into the full amount of water.

Corrosive sublimate, when in solution, has the property of combining very quickly with metals, which not only ruins the metal but

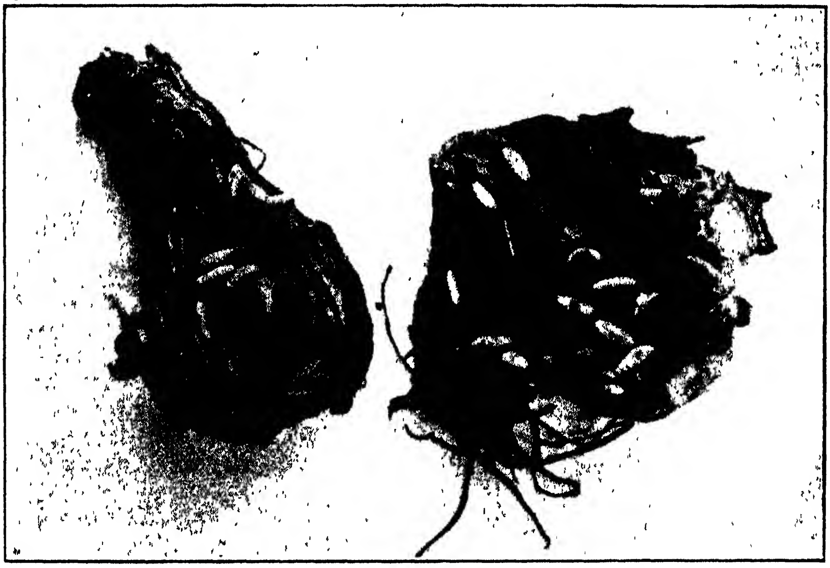


Fig. 3.—Narcissus bulb infested with Lesser Bulb-fly larvae.

breaks down the solution as well. Therefore, it is necessary that the solution should be stored in wooden, earthen, or glass containers and that precautions be taken to see that it does not come in contact with metal at any time. Where metal buckets, sprinkling pots or dippers are used, they should be thoroughly coated with wax, asphaltum, or some similar waterproof material.

After the solution is prepared it is applied to the roots by pouring about half a teacupful on the soil about each plant, thus moistening the soil but not wetting the plant. Care must be taken in making the application not to get the solution on the foliage, since if it does, burning is almost certain to follow. A sprinkling-pot with the "rose" removed and the spout partially plugged, makes as convenient and safe a method of application as we can recommend. All vessels containing the solution, must be covered to prevent livestock, cats, dogs, and poultry, from drinking it. Care must be taken by the operator not

to get any of this liquid on the hands or clothing, since some individuals are very susceptible to mercury poisoning and this particular salt of mercury is easily absorbed.

Corrosive sublimate is a violent poison and this method should be used only by individuals who thoroughly understand what they are doing and who will observe every precaution.

Field Practices

There are certain field practices which if followed persistently will do much toward eliminating the lesser bulb-fly. The field should be carefully inspected frequently and all sick or "unlikely" plants removed and destroyed. The beds should be raked over as soon as the foliage ripens, care being taken to fill in around the neck of the bulb. This will prevent the adults from depositing their eggs on the bulbs themselves and reduce the likelihood of the young larvae reaching their food supply.

If the flies are present in great numbers, and the foliage has ripened but has not yet shriveled away from the bulb, it may be a good policy to cut the tops off as close above the ground as is safe with a hoe and mound the sod over the cut ends. Healthy, vigorous **plants** are not very attractive to the fly.

Protecting Bulbs

When digging bulbs keep them covered so that the flies cannot get to them and deposit their eggs. It is a common complaint among bulb growers that the maggots are always worse the season after transplanting. Bulbs ripened in the shade under a shed, are not attacked by the fly even when the sides are open. All discarded or diseased bulbs heaped about in the field to serve as decoys for egg-laying should be removed frequently, since the development of the fly is very rapid during mid-summer.

Clean culture should be followed persistently, care being taken to get all bulbs out of the field at digging time. Old onion fields in the vicinity of a bulb field should be regarded with suspicion and precautions taken to get the onions either plowed under or all of them off the ground.

SIMPLE ELECTRIC FARM WATER SYSTEMS

Inexpensive Outfit Performs Satisfactorily Where Power Is Available

H. J. GALLAGHER, AGRICULTURAL ENGINEERING SECTION

Farmers having the advantages of electric service either by the single unit plant or by power companies can find many ways of using electric motors to operate equipment already on the farm.

The simple water system is a good example of what can be done by using electric power on a standard windmill or three way farm pump.

Tested On Experimental Line

This system was installed on the Mason-Dansville Electric Test Line and is proving very satisfactory. The pump jack used is designed for operation by an electric motor. The gears, enclosed in a cast housing, run in a continuous bath of oil. The ordinary gas engine pump jack cannot be used with the high speed electric motor unless equipped with a proper size pulley, so that the pump will not exceed forty strokes per minute. This system supplies water at both the house and the barn.

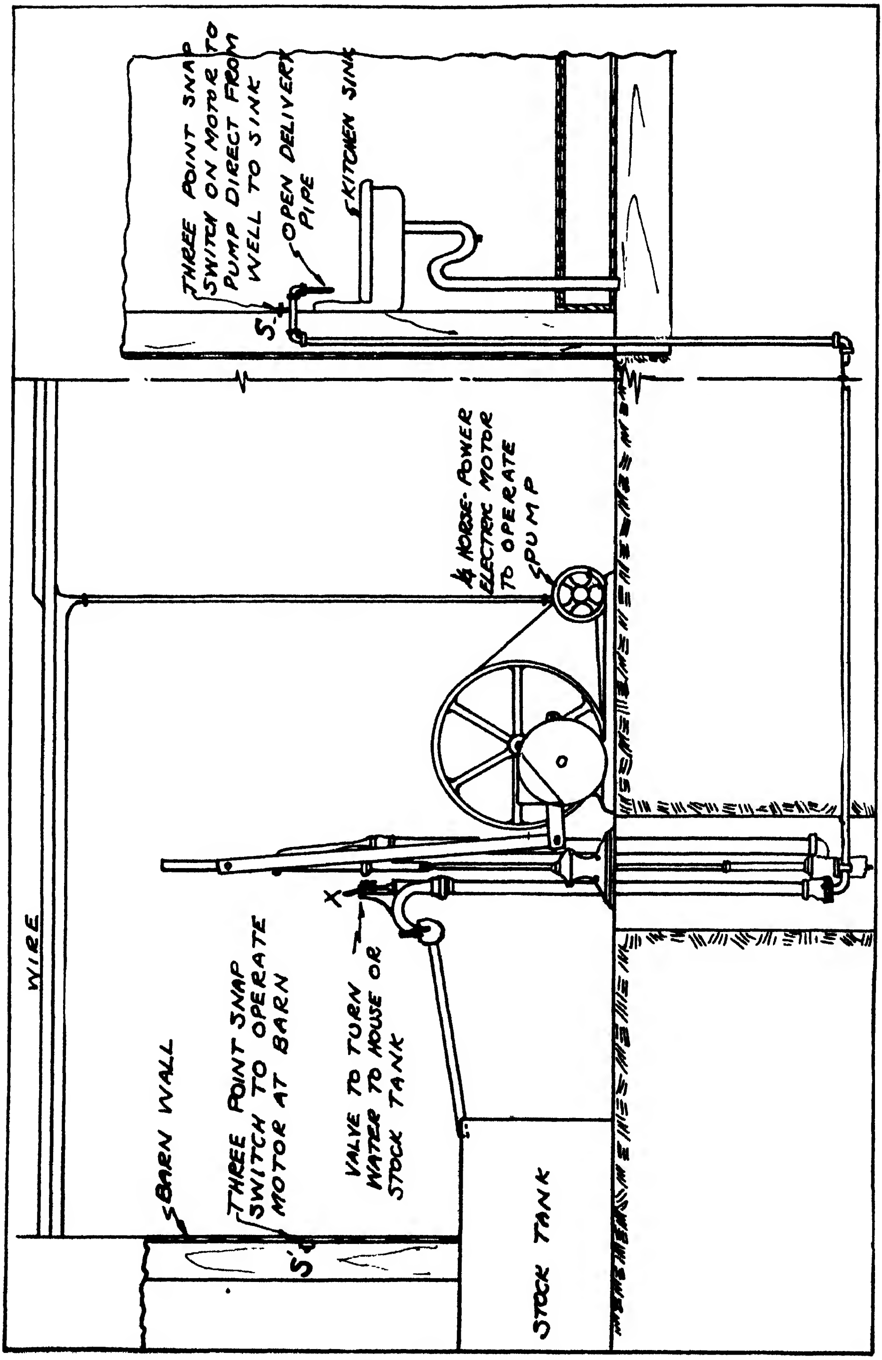
To pump water to the stock tank the lever "X" on the pump is lowered and switch "S" at the barn closed. Except when pumping to the stock tank, lever "X" is raised which permits water to flow through the pipe to the house. The pipe to the house has an open end in place of the usual faucet at the sink. The open pipe at the sing protects the pump. On the wall above the sink back is a three-point snap switch, similar to the switch at the barn above the stock tank.

When water is wanted at the house, the switch "S" is closed instead of opening a faucet. This starts the motor and a fresh supply of water directly from the well flows at the sink. Either the switch at the barn or house will control the motor to pump water.

Eliminates Many Units

In such a system no storage tank, safety relief valves, check valves, automatic switches, or air pumps are necessary. A storage tank could easily be added to this system to provide water for the range or furnace boiler, toilet, and bath.

This system works satisfactory on either a deep or shallow well.



Simplicity is the keynote of this system.

Cost of System

Pump jack	$17.50
¼ H. P. electric motor	12.50
Switches and wiring material	2.80
Pipe and fittings	4.60
Total, not including labor	$37.40

MICHIGAN CERTIFIED SEED POTATOES SHOW QUALITY

Light Crop of 1927 Excellent In Type and Shows Little Disease

H. C. MOORE, FARM CROPS SECTION

The 1927 crop of Michigan certified seed potatoes is approximately 227,000 bushels or 84,000 bushels less than the average annual production of the past five years. Dry weather throughout most of the growing season caused a reduction in yield though it did not injure the quality of the crop. The certified seed this year is of better type than usual and is of medium size. The amount of rough, oversized tubers that must be graded out is very small. It is believed that the general quality of the 1927 certified seed is superior to that of previous years both as to type and in freedom from disease.

The number of acres certified in 1927 was 1,623 compared to 1,571 for 1926. The number of growers who applied for inspection this year was 370 compared to 336 for the season of 1926. Certified seed potatoes were produced this year in fifty counties. The leading seed producing counties were Antrim, Otsego, Emmet, Montcalm, Oceana, and Wexford.

Varieties Under Certification

Eighty-three percent of the 1927 certified seed crop is the Russet Rural or Late Petoskey. Other varieties certified are White Rural, Irish Cobbler, Green Mountain, Bliss Triumph, Spaulding Rose, Early Ohio, and Russet Burbank.

Michigan certified seed potatoes are inspected and certified by the Michigan Crop Improvement Association under the supervision of the Michigan State College. The inspections consist of two field inspections, one bin inspection, and one inspection at the time of loading the potatoes for shipment. All inspections are made by men specially trained for the work by the Michigan State College.

Requirements Are Stringent

In order to pass certification, seed fields must show a uniformly vigorous plant growth, must be free from disease and varietal mix-

tures, and must produce satisfactory yields. Certified seed is graded carefully for type, blemishes, and mechanical injuries. It is sold in 150 pound sacks which are sealed with a lead and wire seal to which the official certification tag of the Michigan Crop Improvement Association is attached.

Thorough inspection and rigid production requirements, which include the planting of hill selected seed, careful rogueing of fields and effective spraying of the plants with bordeaux mixture, insures seed of superior quality. Michigan certified seed planted in 1,300 tests outyielded ordinary seed by an average of 48 bushels per acre. The market quality of the crop from the certified seed was 20 per cent better than that from the non-certified seed. The more general planting of certified seed by Michigan potato growers will help them to produce better potatoes and better yields. It is urged that certified seed be bought early this year. A short crop and a heavy out of state

Fig. 1.—Each dot represents a grower of certified seed potatoes in 1927.

demand will result in the early disposal of certified seed. County agricultural agents and the farm crops department of the Michigan State College can give information on the sources of certified seed.

Fig. 2.—Michigan Certified seed potatoes bear the official certification tag of the Michigan Crop Improvement Association.

VALUE OF PLOWING FOR CONTROLLING BORER TESTED

Experiments Indicate Plow Plays Important Role in Campaign Against Insect

C. B. DIBBLE, ENTOMOLOGICAL SECTION

In an endeavor to obtain more evidence in relation to the value of plowing as an effective part of a practical cleanup program, the following tests were made in order to determine what percentage of corn-borers, if any, survived in fields that had been properly plowed and cleaned.

In order to capture and count the borers which might survive, screened cages were so placed that they enclosed small areas in fields which were known to have been infested during 1926 but which had been plowed in the standard manner ordinarily employed during the cleanup. The cages employed in this experiment were of rectangular form and measured four by eight feet in length and width, by eleven inches in height. They were constructed of tight boards on the sides and ends, with a top covering of wire screen measuring twelve meshes to the inch.

Place Experimental Cages

Thirty cages were placed in six groups of five each. Four of these groups of cages were placed, each group in a field offering various conditions of soil and cover. That is to say, both heavy and light soils were represented. Two fields consisted of bare soil, one was planted to buckwheat, and one to corn. Two other locations were selected in land that had served as experimental plats during 1926 where at that time corn bearing a high infestation had been grown. In the case of these two latter areas, the land had also been covered with additional badly infested corn stalks and manure before plowing. In the case of the first mentioned farm locations, all of them near Monroe, the fields were known to have been heavily infested during 1926 and in all of them either standing corn or tall stubble had been plowed under.

In all the sites mentioned the surface debris had been hand picked immediately after plowing, and the cages were placed on the fields in from ten days to three weeks thereafter, at a time when pupation was just well underway. After the cages were once in place, on June 20th and 21st, observations were made either daily or on alternate days until the moths were through flying or in other words until August 1st.

No Borers Found

In no case during the forty days during which the cages were under observation, were corn-borer moths found.

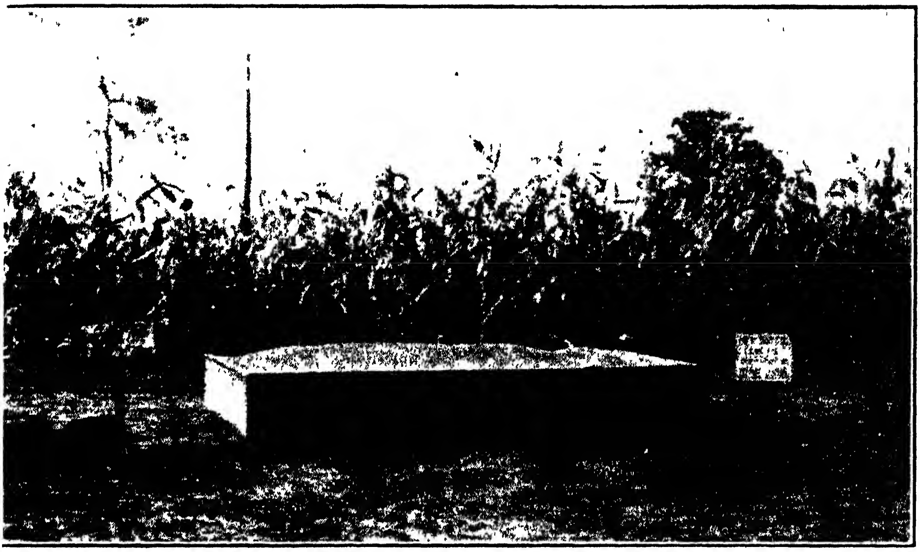


Fig. 1.—Type of cage used to determine the value of plowing as a control measure for corn borer.

The test, so far as it goes, tends to show that in the case of properly cleaned fields, no corn-borers survived in an area of 960 square feet, and while the area was small, it would lead one to believe that plowing did in truth dispose of a goodly number of borers known to have been in the stubble and litter before the land was plowed.

SOME RESULTS OF THE MICHIGAN WOODLOT TAX ACT

Farmers Find Law Gives Relief From Tax Burden On Woodlots

KARL DRESSEL, FORESTRY SECTION

The present Michigan woodlot tax reduction act was passed by the State Legislature in 1917. The object of the act is to aid farmers to retain a little woodland on their farms. This state aid is obtained by delaying the heavy tax upon the woodlot until the time of harvest, when the owner is better able to stand the burden.

Under this act, on a 160 acre farm where one-half or 80 acres is in agriculture, one-fourth or 40 acres may be exempted as a forest reserve under certain rules and regulations. These rules and regulations do not place an undue burden upon the landowner, they are for his own

protection and that of his local taxing district. In reality these rules and regulations are merely fundamental principles of good woodlot management, which, if followed, will keep the woodlot at maximum capacity and help produce better quality products.

Assessment of Exempted Woodlots

The State, through the local township supervisor places a taxable value of $1 per acre upon the accepted woodlots. This makes the actual tax but a few cents per acre per year.

In addition, the woodlot owner, is required to pay a five per cent cutting tax on the actual stumpage value when the timber is harvested. If, however, the owner wishes to use the products for himself or tenant, there is no cutting tax.

To take advantage of this act, the owner must fill out an application blank and file it with the county treasurer in the county in which the woodlot is located. The county treasurer in turn notifies the local township supervisor who makes an inspection of the tract at the time of the annual assessment of property in the district.

In Gratiot county, one landowner has applied for tax reduction under this act. This landowner has a total farm area of 300 acres, including 39 acres of woodland. This tract was placed under the woodlot tax reduction act in 1923.

Valuation Reduced

The total farm area, inclusive of the woodlot, was valued at $16,700 in 1923. In 1924, after placing the 39 acre woodlot under this act, his total valuation was placed at $15,200—a reduction in valuation of $1,500. This valuation remained constant in 1925, but was again reduced in 1926 to $12,000.

The valuation of all the other landowners in this same section remained stationary from 1923 through 1926, except one and his valuation was advanced in 1924 and has remained stationary through 1926.

In Emmet county, one landowner has applied for tax reduction on his 14 acre woodlot. This woodlot consists of a natural stand of beech and maple of which some is merchantable at the present time. The owner stated in answer to an inquiry sometime ago that the act was working out very satisfactorily in his case.

The township tax records in the county treasurer's office show the total valuation placed on this 80 acre farm, inclusive of the 14 acre woodlot, in 1921 was $1,100. The owner applied for tax reduction on the 14 acre woodlot in 1922 and his valuation was then placed at $900—a reduction of $200. This same valuation remained stationary through 1926.

The other landowners in the same half section all remained stationary from 1921 through 1926.

In Muskegon county, four landowners have applied for tax reduction on their woodlots.

One landowner filed an application for tax reduction on his nine acre woodlot in 1922. This woodlot consists of a natural hardwood stand with some of the oaks now merchantable as logs, but the majority of the trees are too small to be harvested.

In 1923, the township supervisor placed a valuation of $4,000 on this 80 acre farm, inclusive of the nine acre woodlot. In 1922, after placing the nine acre woodlot under the tax reduction act the total valuation was placed at $3,700 or a reduction of $300. This valuation remained constant until 1926 when it was placed at $3,900.

Receives Only Reduction

This landowner was the only one in the entire section to receive a reduction in valuation from 1923 through 1926. All the land in this section was advanced in valuation in 1926 as was this land under the woodlot tax reduction act.

Another landowner applied for tax reduction on his 40 acre woodlot in 1924. This woodlot consists of a natural hardwood stand of oak and maple. Some of the trees are now merchantable as logs, cordwood, and railroad ties.

The tax records in the county treasurer's office show that the township supervisor placed a valuation of $4,600 in 1924 on the 120 acre farm inclusive of the 40 acre woodlot. The owner applied for tax reduction on this woodlot in 1925 and the total valuation placed upon the farm and woodlot was $4,500, or a reduction of $100 in valuation. In 1926, the valuation on the total farm area was advanced to $4,750. There was a proportionate raise over the entire section. This landowner was the only one in the entire section to receive a reduction in valuation in 1925.

The other two woodlot owners who have applied for tax reduction on their woodlots have been under the act only a short time, so it is impossible, at this time, to draw any conclusions as to the results of listing these woodlots under this act.

Three landowners in Montcalm county have applied for tax reduction on their woodlots under the Michigan woodlot tax act.

One landowner placed his 36 acre woodlot under this act in 1923. The woodlot consists of a natural stand of beech, maple, oak, ash, and black cherry. Some of the trees are now merchantable as logs, ties, and cordwood.

Figures Taken From Records

The township tax records in the county treasurer's office show that the township supervisor placed a valuation of $14,600 on this 168 acre farm, inclusive of the 36 acre woodlot, in 1923 when this landowner applied for tax reduction on his 36 acre woodlot. The valuation placed against the 168 acre farm in 1924 was $10,800, a reduction in valuation of $3,800. This valuation was again reduced in 1925 to $10,600 and again reduced in 1926 to $7,600.

The woodlot was listed and taxed separately after being placed under the tax act. This valuation was placed at $40 and remained stationary through 1926. In actual taxes, the 36 acre woodlot paid in 1924, $0.64; in 1925, $0.71; and in 1926, $0.85, or less than $0.02½ per acre per year.

The valuation of other land in this same section remained about stationary from 1923 through 1924, and they all received about a proportionate reduction in valuation in 1925 and 1926.

Another landowner in this county placed his 40 acre woodlot under the Michigan woodlot tax reduction act in 1923. The woodlot consists of a natural stand of beech and maple. The total farm area consists of 360 acres of which 200 acres are under cultivation.

The township tax records in the county treasurer's office show that the total valuation placed against the 360 acre farm was $27,600 in 1922. The landowner applied for tax reduction on his 40 acre woodlot under the Michigan woodlot tax act in 1923 and the valuation on the total farm area was $25,040, a reduction in valuation of $2,560. This valuation was reduced to $24,800 in 1924, $23,500 in 1925, and $23,100 in 1926.

Woodlot Listed Separately

The woodlot was listed and taxed separately on a valuation of $40 for the 40 acres after listing under the act in 1923 and remained stationary through 1926. In actual taxes this 40 acre woodlot under the tax reduction act payed $0.68 in 1923, $0.62 in 1924 and $0.59 in 1925 and $0.84 in 1926. The actual taxes were less than $0.02½ per acre per year.

This landowner was the only one to receive any appreciable reduction in valuation in this section in 1923, the year his woodlot came under the tax act. The other reductions from 1923 through 1926 were in acordance with the general reduction in valuation over the entire section.

Another landowner in this county applied for tax reduction under the Michigan woodlot tax reduction act in 1923. His 20 acre woodlot consists of a natural stand of oak and sugar maple with about 50 per cent merchantable at the present time. The total farm area consists of 160 acres of which about 140 acres are under cultivation.

The township tax records in the county treasurer's office show that this 160 acre farm was valued in 1922 at $16,800. In 1923 this landowner applied for tax reduction on his 20 acre woodlot and the valuation on the total farm was placed at $14,500 or a reduction of $2,300. This valuation was again reduced to $12,000 in 1924, and raised to $13,000 in 1925, and remained stationary through 1926. The 20 acre woodlot paid an actual tax of $0.30 in 1926, or about $0.01½ per acre per year.

This landowner was the only one in this section to have his valuation reduced in 1923. The reduction in valuation in 1924 and 1925 was general throughout the entire section and each landowner seemed to fare about alike in this reduction.

Another landowner in this county applied for tax reduction on his woodlot under the Michigan woodlot tax exemption act in 1925. The woodlot consists of 17 acres of sugar maple and basswood. The total farm area consists of 180 acres, of which 120 acres are under cultivation.

The township tax records in the county treasurer's office show that the farm was assessed at $13,000 in 1924. After applying for the tax reduction in 1925 in the 17 acre woodlot, the valuation upon the farm was placed at $10,200, or a reduction in valuation of $2,800. This valuation remained stationary through 1926.

The other landowners in this same section also received reductions

in their valuations in 1925, but their reductions were small in proportion to the landowner whose woodlot was listed under the tax act.

There are many woodlots in the State that are eligible under this act. The Department of Forestry at the Michigan State College will be glad to send a copy of the act and application blanks for listing land to any one interested.

TESTED METHODS FOR WATERPROOFING CONCRETE

Proper Construction Practices Insure Dry Floors and Basements

F. E. FOGLE, AGRICULTURAL ENGINEERING SECTION

Since the earliest days of the manufacture of Portland Cement in this country, the need for preventing the absorption of water by concrete has been a very important factor and the need for preventing water from passing through concrete tanks and basement walls continues to be a problem on the majority of Michigan farms.

In the case of new work, the first precaution to take in making concrete waterproof is to make a correct mixture of concrete. Theoretically, a perfect mix for concrete should be waterproof; that is if the concrete is mixed in such proportions that all of the voids are filled, there will be no possibility for moisture to pass through. Concrete consists of particles varying in fineness from that of the particles of the cement, which is often as fine at 1/200 of an inch in diameter, to the stones in the gravel. The voids between the stones are filled by the particles of the sand and the voids between the sand are filled by the particles of cement. In practice it will be found that good concrete will be waterproof, and precautions should be taken on a wall that is desired to be waterproof to make the concrete as strong and dense as possible.

Carelessness Injures Quality

Concrete as usually made falls far short of the possibilities which may be attained in strength, density, and waterproofness. The strength, density, and waterproofness depend upon two fundamental laws of proportion which are:

1. With the same sand and gravel, that concrete will be the strongest and most dense which contains the greatest amount of cement.
2. With the same percentage of cement, that concrete will be the strongest and most dense which has the materials correctly proportioned.

The first of these laws, to increase the strength and density with the increasing of the cement in the mix, is generally understood and

followed. One should keep in mind that increasing the percentage of cement is not an economical method for getting strength and density.

The second law, to increase the strength with the increase of density, is not so closely followed. It is, no doubt, well understood that the material should be free from clay and organic matter. The greatest density is secured when the size of the sand and gravel is graded from fine to coarse as discussed in a previous paragraph. A 1:2:3 mix is considered to be very good, meaning one part of cement, two parts of sand and three parts of gravel. Sand is taken to be all material of a gravel which will pass through a ¼" screen and gravel the particles which will not pass through a ¼" screen. Gravel may be as coarse as 1½" to 2" in diameter for ordinary foundation work, but coarser material should not ordinarily be used. The rule which is usually followed is that the largest stones should not be more in diameter than ¼ of the thickness of the wall. Bank run gravel usually contains too much sand and requires too high a percentage of cement to make an ideal mix.

Amount of Water Important

The quantity of water which goes into the concrete mix has a great deal to do with the strength and density and consequently the waterproofness of the concrete. With any given mix, the quantity of mixing water determines the strength of the concrete so long as the mix is of workable plasticity. The rules ordinarily used for proportioning concrete usually fail to give proper attention to the quantity of water in the mix. Experimental work has emphasized the importance of water in concrete mixes and shows that water is one of the most important ingredients since very small variations in water content produce important variations in the strength and density of the concrete. One pint of water more than necessary to produce a plastic cement reduces the strength as much as to reduce one to three pounds of cement from a bag mix. Since the amount of water contained in the sand or gravel varies greatly, no rule for actual quantity of mixing water can be given. Without regard to the actual quantity of mixing water the following rule is a safe one to follow:

"Use the smallest quantity of mixing water that will produce a plastic or workable cement."

Enough water should be used so that when mix the material will begin to slump down when piled in a cone shaped pile. Another test is that the pile will quake slightly when patted with the back of a shovel.

Methods of Waterproofing

Concrete, itself, may be made waterproof by carefully selecting and compounding the ordinary ingredients of the mix, or, if such care is impractical, a permeable concrete can be waterproofed by one of the four methods which will be described.

The integral method of waterproofing concrete is the uniform distribution throughout the concrete of some insoluble water repellant material in sufficient quantity to make the concrete waterproof. Since waterproofing is done by producing a very dense concrete through which water cannot pass, the use of hydrated lime which is extremely

fine helps to fill the smallest voids into which the cement particles do not readily fit. Lime may be added to the mix to the extent of not more than 10% of the weight of the cement. Alum and soap makes a water repellant. To make this mixture dissolve a pound of alum in two gallons of water, also dissolve one pound of soap in 3½ gallons of water. The two solutions are then mixed. Use this solution instead of water in mixing the concrete. Stir the solution frequently to prevent materials from accumulating on the surface. There are several products on the market to mix with concrete for waterproofing. While some of them may weaken the concrete, with the majority of them there is no detrimental effect. The integral method of waterproofing is economical and does not require that an additional excavation be made on the exterior of the basement walls as is necessary when surface treatment is resorted to.

A second method for waterproofing concrete is by means of a cement wash or a cement plaster applied to the surface. A cement wash is

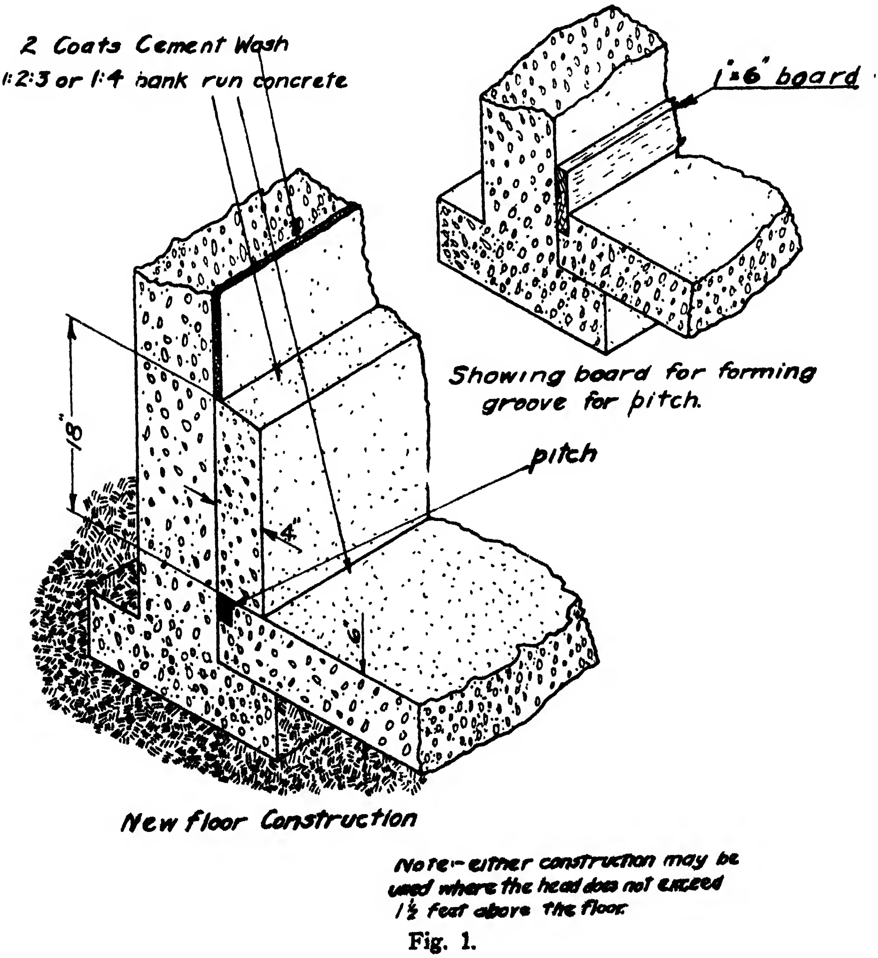


Fig. 1.

made up by mixing pure cement and water to the consistency of a thick cream. This wash is applied with a brush or broom. It is best applied to fresh clean cement. If applied to old cement, the old cement must first be cleaned and washed with a 10% solution of muriatic acid and again rinsed clean. Cement plaster is made of one part of cement and two or three parts of finely screened sand to which may be added not more than 10% of hydrated lime. The lime is added to make the cement work more freely under the trowel and to retard its setting. The cement is applied to the cleaned surface of concrete to a thickness of one-half of an inch to one inch. The cement plaster method is permanent and inexpensive and gives a clean pleasing surface, but it can be used only in cases where the water pressure is against the

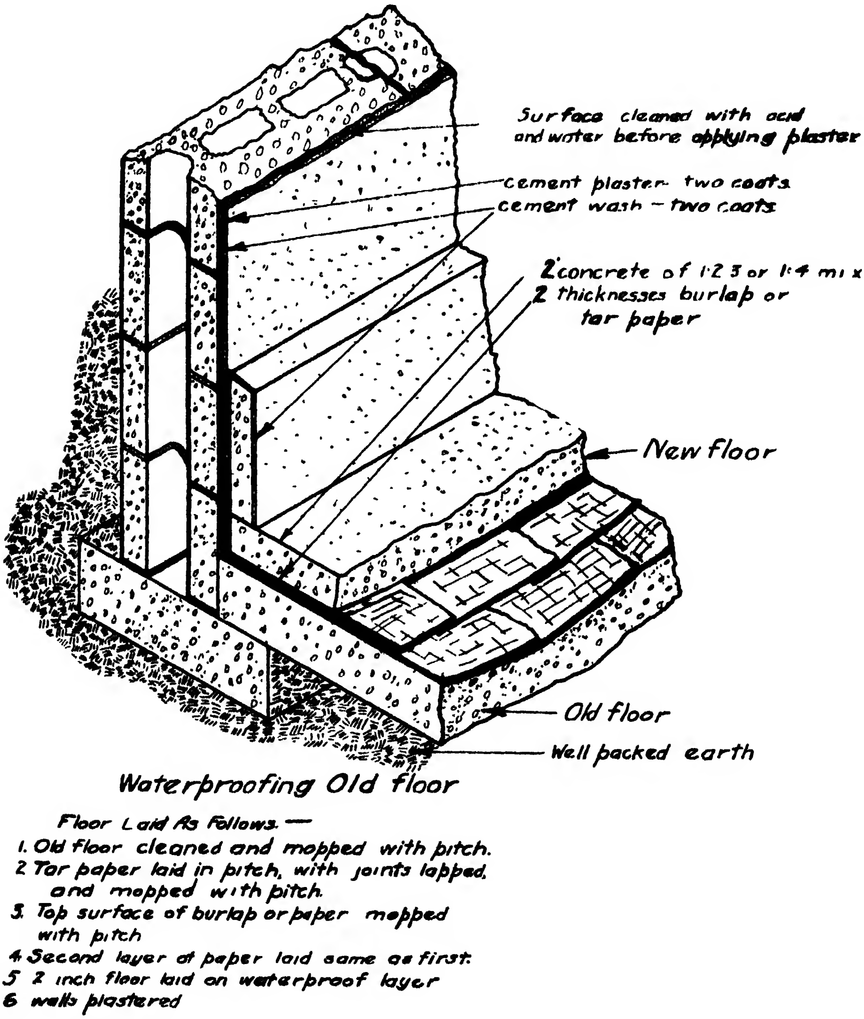


Fig. 2.

cement plaster, as in a cistern tank or outside of foundation wall, and cannot be used in such places as the inside of the basement when the water pressure is from the outside.

The third method for waterproofing is the membrane method which consists of a coat or successive coats of asphaltum or some bituminous mixture. Asphaltum may be applied cold or hot. When applied cold, a mixture of asphaltum and naphtha or some other substance which will evaporate readily is used. After being applied the naphtha evaporates leaving a coating of asphaltum. It is usually wise to apply more than one coat when applied cold and is a more expensive method. Pure asphaltum may be applied to a clean, dry, concrete surface. The asphaltum not only should be melted but it also should be hot enough so that it will penetrate as much as possible. More than one coat may be applied if necessary. It is needless to say that to secure a perfect bond, asphaltum should be applied only to a clean surface. Layers of felt or paper are very frequently interposed with layers of asphaltum. This method is particularly recommended where there is a pressure of water. When asphaltum is applied to the inside of a basement or inside of a tank, two inches of concrete should be poured after the asphaltum is applied.

A fourth method for waterproofing consists of the application of a metallic mixture to the surface of the concrete, and can be used only in cases where the surface is reasonably smooth and tight. These metallic mixtures are made up in such a way that, after being applied and entering the pores of the concrete, oxidation, which expands the material and renders the surface waterproof, takes place. This is the only class of material that can be applied to the inside of a wall such as a basement wall when the water pressure is from the outside. While this class of material has in the past been used only by experienced workmen and on larger jobs, its use is rapidly becoming general.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experimcnt State, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

251 Insects of 1907.
258 Insects of Field Crops.
262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
273 Utilization of Muck Lands.
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

58 Foul Brood.
65 Hog Cholera and Preventive Treatment.
71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
74 Analysis of Some Materials Sold as Insecticides and Fungicides.
76 Transferring Bees.
79 Michigan's Shifting Sands; Their Control and Better Utilization.
80 Yellow Rocket (a dangerous weed).
82 Durability of Concrete Drain Tile No. 11.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Some General Information on Lime and Its Uses and Functions in Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
99 The Detroit Commission Plan of City Milk Administration.
100 Soy Beans.
101 Oats in Michigan.
103 Forest Planting in Michigan.
104 Soils of Detroit Area.
105 Rosen Rye.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
109 Dependable Michigan Crop Varieties.
110 Special Report of the Upper Peninsula Experiment Station.

111 Studies in City Milk Distribution.
116 The Agriculture of the Upper Peninsula of Michigan.
118 Pruning Fruit Trees.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
121 Grape Production in Michigan.
122 Improvement of the Farm Woodlot.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.
132 Field and Garden Insects.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management of Commercial Apiaries.
136 The Muck Soils of Michigan.
137 Marketing Michigan Potatoes.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
148 Some Important Grape Insects.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs for Landscape Planting in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
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***Bulletins listed in bold faced type are recent publications of this Station.**

*ANNOUNCING *

Michigan Special Bulletin No. 164
DIAGNOSING ORCHARD ILLS

V. R. GARDNER, R. H. PETTIT, C. W. BENNETT, AND W. C. DUTTON

(p. 1-71; Figs. 1-81; Colored plates 1-8.)

This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it upon the receipt of ten cents (coin or stamps).

***166 Studies in Orchard Management with Special Reference to Cherry Production.**

Circular Bulletins—

28 The Bean Maggot in 1915.
34 More Wheat for Michigan.
37 Raspberry Culture.
41 State Laws Governing and Protecting the Planting of Street Trees.
43 Increasing the Production of the Bearing Apple Orchard.
44 The European Corn Borer.
47 Poisoning from Bacillus Botulinus.
49 The Hessian Fly.
50 Hairy Vetch.
52 The Grape Berry Moth in 1922.
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55 Lime Requirement for St. Joseph County.
56 Lime Requirement for Cass County.
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58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paving for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
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75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
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80 Fertilizer Suggestions for Muskegon County Soils.
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104 Clothes-Moths and Carpet Beetles.
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13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat.
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
22 Effective Crop Exhibits.
23 Alfalfa.
24 Utilizing Poles and Timber in Farm Buildings.
25 Feeding Cull and Surplus Potatoes.
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55 Plowing for European Corn Borer Control.
59 Methods of Control for the European Corn Borer.

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24 The Freezing Point Method as a New Means of Measuring the Concentration of the Soil Solution Directly in the Soil.
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29 Keeping Qualities of Butter.
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32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacturium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
40 Physiological Balance in the Soil Solution.
48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
53 A Phoma Root Rot of Celery.
56 Leafhopper Injury to Potatoes.
57 Studies on Active Bases and Excess Acids in Mineral Soils.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.
62 Some Physical and Chemical Properties of Several Soil Profiles.
63 A Study of the Early Blight Fungus, Cercospora Apii Fres.
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66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
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76 Concentration of Materials and Rates of Application in the Control of Apple Scab.
77 The Influence of the Reaction of Cultural Medium on the Growth of the Strawberry Plant.

78 The Effect of Certain Nutrient Conditions on Activity of Oxidase and Catalase.
79 Tests for Incipient Putrefaction of Meat.
80 Virus Diseases of Raspberries.
81 Storage and Transportational Diseases of Vegetables Due to Suboxidation.
82 Commercial Casein.
83 A Study of the Sanitary Significance of Air in Relation to Ice Cream.

Nature of Publications—

Five series of publications are issued by the Experiment Station—Regular, Special, Circular, Technical, and Quarterly.

Regular bulletins include all publications reporting investigation work in connection with subjects of general interest and handled in a more or less popular way.

Special bulletins are bulletins of a popular nature, and deal with special lines of work.

Circulars are briefly and concisely written discussions of a popular nature.

Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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Single Copies of bulletins are for free distribution as long as the supply lasts. Quantities of bulletins may be secured at cost.

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Order by classification and number.

All applications for bulletins should be addressed to R. S. SHAW, DIRECTOR, East Lansing, Mich.

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South Haven, Van Buren County, 10 acres rented; 5 acres deeded. S. Johnston, Supt.
Graham Station, Kent Co., 50 acres donated by R. D. Graham; 50 acres purchased. H. M. Wells, Supt.
Dunbar, Chippewa County, Forestry station, 577 acres deeded.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

THE QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

East Lansing, Michigan

VOL. X FEBRUARY, 1928 NO. 3

northern markets. In addition, large importations of alfalfa seed from Argentina and from the Mediterranean and South African regions are frequent, but under the operation of the Gooding-Ketcham Act the Argentine seed is now stained orange-red to the extent of 10% before being permitted to enter the United States and the African and Mediterranean seed 10% red. Canadian alfalfa seed is well adapted and is stained 1% purple.

The desirability of planting adapted strains produced under proper climatic conditions, has been fully established, but care must be exercised by all growers so that they may be assured that the seed purchased is of proper variety and produced under climatic conditions which will enable it to withstand Michigan conditions.

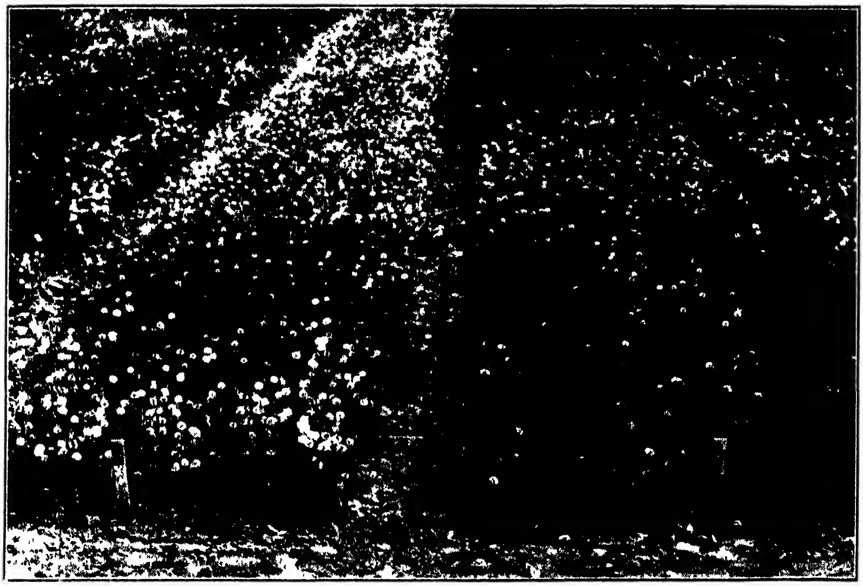


Fig. I -Commercial seed from South America winter kills badly and should not be used under Michigan conditions. (Left)
II—Grimm, a hardy variegated strain, is exceedingly well adapted to Michigan conditions. (Right)

The seed planted in the tests herewith described, was, for the most part, gathered at the thresher spout in production areas, or secured from the Bureau of Plant Industry, United States Department of Agriculture, or from dependable trade sources.

In the spring of 1921, the Farm Crops Section established at East Lansing a series of alfalfa plats. Seed which had been secured from many of the larger seed producing sections of the United States and of foreign countries was used. The object of this test was to determine the relative value, for Michigan conditions, of seed from the various sources. The accompanying tables show the relative yields of air-dry alfalfa hay grown from seed from these various sources.

In the spring of 1922, another seeding, known as Series "B" was made.

Yield Records of Alfalfa Series A, Seeded 1921. Michigan Agricultural Experiment Station.

Strain	Source	Yield tons hay per acre—12% moisture						
		1922	1923	1924	1925	1926	1927	Average
Group I:								
Hardigan	Michigan	5 58	7.21	7.85	3.12	3.93	3.83	5 25
Grimm	Idaho	5 63	7.09	7.68	2 60	3.28	3.10	4.89
Grimm	S. Dakota	5 56	6.63	7.41	2 53	3.26	3 05	4.74
Group II:								
Common	Montana	5.11	6 39	7.36	2.52	3 00	2.78	4.52
Common	Utah	5.15	6 06	6 92	2.07	1 94	1.78	3 98
Common	Idaho	4 91	5 48	6.51	1.87	1.71	1.83	3.70
Group III:								
Peruvian	Arizona	3 83	1 11	1.74	0.32	0	0	1.16
Common	Arizona	3 90	0 92	1.55	0.38	0	0	1.12

This series contains somewhat the same strains as Series "A" and the results are quite similar, as shown by the data in Table 2.

Table 2.—Yield Records of Alfalfa Series B, Seeded in Spring of 1922.

Strain	Source	Yield tons hay per acre—12% moisture						
		1923	1924	1925	1926	1927	Ave.	Total 5 years
Group I:								
Hardigan	Michigan	5 96	6 24	2 86	3 50	3 84	4.48	22.40
Cossack	S. Dakota	6 23	6.21	2.68	3 17	3.87	4.43	22 16
Grimm	S. Dakota	6.23	6 18	2.74	2 97	3.37	4.29	21 49
Grimm	N. Dakota	5.99	6 02	2.83	2 93	3.40	4.23	21.17
Grimm	Idaho	5.88	6.12	2.76	3.10	3.25	4.22	21.11
Group II:								
Common	S. Dakota	5.64	6 23	2.75	3 04	3.22	4 17	20.88
Common	Kansas	5 46	5.71	2.71	2.96	3.32	4 03	20.16
GroupIII:								
Peruvian	Arizona	5.35	4 23	0.14	0	0	1.95	9.72

In the spring of 1923, another seeding, known as Series "C" was made. This series contains several imported lots which have proved to be *decidedly inferior*, as shown in Table 3.

The season of 1925 was exceedingly dry; consequently the yields of both the domestic and imported lots were somewhat less than for 1924. The imported lots winter-killed badly during the winter of 1923-1924, however, and their yield was reduced considerably more than that of the domestic lots.

In the spring of 1924, Series "D" was seeded on a well drained piece of muck land. The Hardigan, Grimm, Cossack, and Ontario Variegated withstood the winter in excellent condition with stands of from 95 to 100 per cent. The South American lots, consisting of seed from San Rafaela Mendoza, Bahia Blanca, and Rio Negro suffered so heavily from winter killing that the stand was not worth leaving. The South African lot completely winter killed the first winter.

Table 3.—Alfalfa Series C Seeded in the spring of 1923. Comparative Yields of Domestic and Imported Strains.

Strain	Source	Yields of hay—tons per acre					
		1924	1925	1926	1927	Ave.	Total
Domestic:							
Hardigan	Michigan	5 43	3 03	3 93	4 11	4 12	16 50
Labeau	Michigan	5 41	3 25	3 77	4 20	4.15	16 63
Cossack	Utah	5 38	2 97	3 67	4 16	4 04	16 18
Grimm	S. Dakota	5 30	3 35	3 74	3 64	4 00	16 03
Grimm	Idaho	5 38	3 25	3 61	3 58	3.95	15 82
Common	Utah	5 29	2 73	3 15	3 34	3.62	14.51
Imported:							
Turkestan	Turkestan	4 57	1 91	3 33	3 51	3.33	13 32
Argentine	35° S. Argentine	5 29	1.45	2 68	2 90	3 08	12 32
Chubut	Argentine	4 13	1 03	1.96	2.17	2 32	9 29
Argentine	45° S. Argentine	4 06	0 9[illegible]	1.85	1.96	2.20	8 83

From the foregoing tests it is quite evident that the Hardigan, Grimm, Cossack, and Ontario Variegated strains are winter hardy, high yielding strains, and are exceedingly well adapted to Michigan conditions.

It is apparent that there are a few common strains which, when seeded under favorable conditions, will give fair yields but they are not as dependable as the Hardigan, Grimm, Cossack, or Ontario Variegated strains.

These tests show also that Arizona Common, Hairy Peruvian, and other southwestern strains and the strains imported from Argentina, South America, and from South Africa are entirely unsatisfactory for seeding under Michigan conditions because of their lack of winter hardiness and consequent inability to produce yields in this climate.

THE COMBINE HARVESTER OPERATED IN MICHIGAN

Costs of Harvesting With Combine Computed For Michigan Conditions

BY E. E. SAUVE, AGRICULTURAL ENGINEERING DIVISION

The 1927 grain harvest presented to our Michigan farmers the first opportunity to observe the harvester combine in operation.

There were seven of these combines operating under the observation of the Agricultural Engineering Department staff. These seven machines representing three different makes were owned by and located as follows:

Milton Shear, Flushing
E. A. & W. A. Smedley, Durand
The Detroit Creamery Company, Mt. Clemens
Norman Pattie, Milan
Ralph Smith, Britton
John Bidle, Riga

The Detroit Creamery Company used two of these combines.

Combine Common in West

The combine has been used in the West for a number of years but it is only within recent years that the small combine with 8, 9, and 10 foot cuts has been used in the Middle West.

A 10-ft. combine in oats on the Detroit Creamery Farms, Mt. Clemens. Three of the individuals on the machine are spectators.

It was thought that this machine would not prove successful in the humid sections of our country; and thus the manufacturers were slow to urge the use of the combine in Michigan and neighboring States. In the face of this situation, however, 9 machines were placed in the State this year, two of which were not used during the grain harvest. The demand for the machines came largely from the farmers themselves. In fact, one owner, John Bidle, Riga, produced some elaborate figures to convince the dealer that he would lose considerable money if he could not obtain his combine for the 1927 harvest.

All of the seven machines were delivered and set up just prior to the wheat harvest. Naturally there were some delays in adjusting the machines for the conditions to be met. At the conclusion of the grain harvest, however, all six owners expressed the belief that the combine had proved its worth as a practical machine for Michigan last year.

Kind of grain combined	Acreage combined	Average yield per acre in bu.	Total yield in bushels
Wheat	344	25 6	8804
Rye	30	25	750
Barley	86½	30	2595
Oats	181	47	8507

Kinds of grain with their acreages and yields.

Size of Farms

The average size of the farms on which the combines were used, exclusive of the Detroit Creamery Farms, was 230 acres. The average grain acreage combined for all six farms was 107 acres.

Land Topography

In all cases of combine use, the land was level or nearly so. No attempt was made to try these machines on hilly land. Due to the season, there was no unevenness in the ripening of the grain, thus eliminating the objection which is sometimes raised against the successful use of the combine.

Shattering of Grain

The average time allowed for the grain to stand after the ordinary time for cutting with the binder was from one week to two weeks. There was no noticeable losses from shattering of the grain due to over-ripening in any case. A severe hail storm, August 7, practically leveled a field of barley belonging to Ralph Smith, Britton. The combine because of its wide range of adjustment picked up most of the grain, and the loss occasioned by the storm was small.

Straw

Perhaps the greatest criticism of the combine was its apparent inability to save the straw for bedding purposes. The straw was usually spread back of the machine and later turned under with the plow. Some of these combines were equipped with windrowing attachments which enabled the owner, if he wanted to save the straw, to handle it the same way be would hay. Norman Pattie left about 22 inches of straw standing during the combine operation and later went into the field with a mower and cut as much as he needed for bedding purposes. Another operator used shredded corn fodder for bedding, preferring to turn under all his straw for organic matter. These combines were not designed to handle full length straw such as is found in Michigan, and where this was tried, the machine was found wanting in this respect. No doubt, there will be changes brought about in the near future to remove this objection.

Cost of Operation

The cost of operation of any field machine is difficult, if not impossible, to accurately determine. The skill of the operator is most important in this respect. Naturally, with only one year of use in Michigan, the life of the combine is merely an estimate. Let us assume then that a reasonable length of life is ten years of combining on an average of 200 acres per year, or combining throughout its natural life 2,000 acres.

This may be a low estimate, but we believe these cost figures to be fairly accurate and they will enable the prospective owner of a combine to estimate the cost of operation before purchase rather than after. These figures include all fixed and operation charges on both combine and tractor but do not include the cost of handling the grain after it is threshed. The fixed charges are made up of depreciation, interest on the investment, insurance, taxes, housing, and repairs.

Fixed and Operating Costs of a Ten Foot Combine with Separate Motor and Two Men

Original investment	$1,500.00
Acres combined per year, two men with outfit... 200	
Estimated life of combine and motor .... 10 years	

Combine and Motor Fixed Costs

Depreciation	150.00
Interest at 6%	90.00
Taxes and housing 2%	30.00
Repairs of combine and motor 4%	60.00
Total yearly fixed costs	$330.00

Combine and Motor Operating Costs

Fuel—1 pound per h. p. hour

16 h. p. x 10 x 1 equals 160 pounds per day of 20 acres cut

160 x 10 equals 1600 pounds per year

$\frac{1600}{6.75}$ pounds equals 237 gallons per year

237 x .14 equals fuel cost	33.18
Oil cost at 2 quarts per 10 hour day for 10 days at 80c per gallon yearly	4.00
*Labor—1 man at 50c per hour for 12 days	60.00

Tractor Costs 10-20 h. p.

*Fixed and operating costs $8.00 per day, less labor for 12 days	96.00
*Labor cost—1 man at 50c per hour for 12 days	60.00
Total yearly costs	$583.18

583.18 divided by 200 equals $2.92 per acre.

*Note: Tractor and labor costs are based on 12 days of 10 hours each to provide for greasing, oiling, filling, adjusting, and repairing.

On a 20 bushel per acre yield, cost per bushel equals	14.6c
On a 25 bushel per acre yield, cost per bushel equals	11.7c
On a 30 bushel per acre yield, cost per bushel equals	9.7c
On a 35 bushel per acre yield, cost per bushel equals	8.4c
On a 40 bushel per acre yield, cost per bushel equals	7.3c

Based on similar figures the fixed and operation costs of 10 ft. combine with power take off and one man is $2.24 per acre.

On a 20 bushel per acre yield, cost per bushel equals	11.2c
On a 25 bushel per acre yield, cost per bushel equals	9.0c
On a 30 bushel per acre yield, cost per bushel equals	7.5c
On a 35 bushel per acre yield, cost per bushel equals	6.4c
On a 40 bushel per acre yield, cost per bushel equals	5.6c

Marketing

In one case where a truck was hired to draw from the combine to the elevator the charge was 3.6c per bushel. For wheat with an average yield of 25.6 bushels per acre, the marketing cost would be 92c an acre.

Conclusion

The rainfall for the period of the harvest was the lowest recorded in years. With one exception August was the dryest month on record during the past 40 years. This presented an ideal condition for the operation of the combine. Perhaps another year will be different. From interest manifested during the past season, there should be a considerable increase in the number of combines operating in Michigan next year. With a possibility of adverse weather conditions the combine in Michigan will be put to a further test.

ELECTRICALLY OPERATED INCUBATOR SATISFACTORY

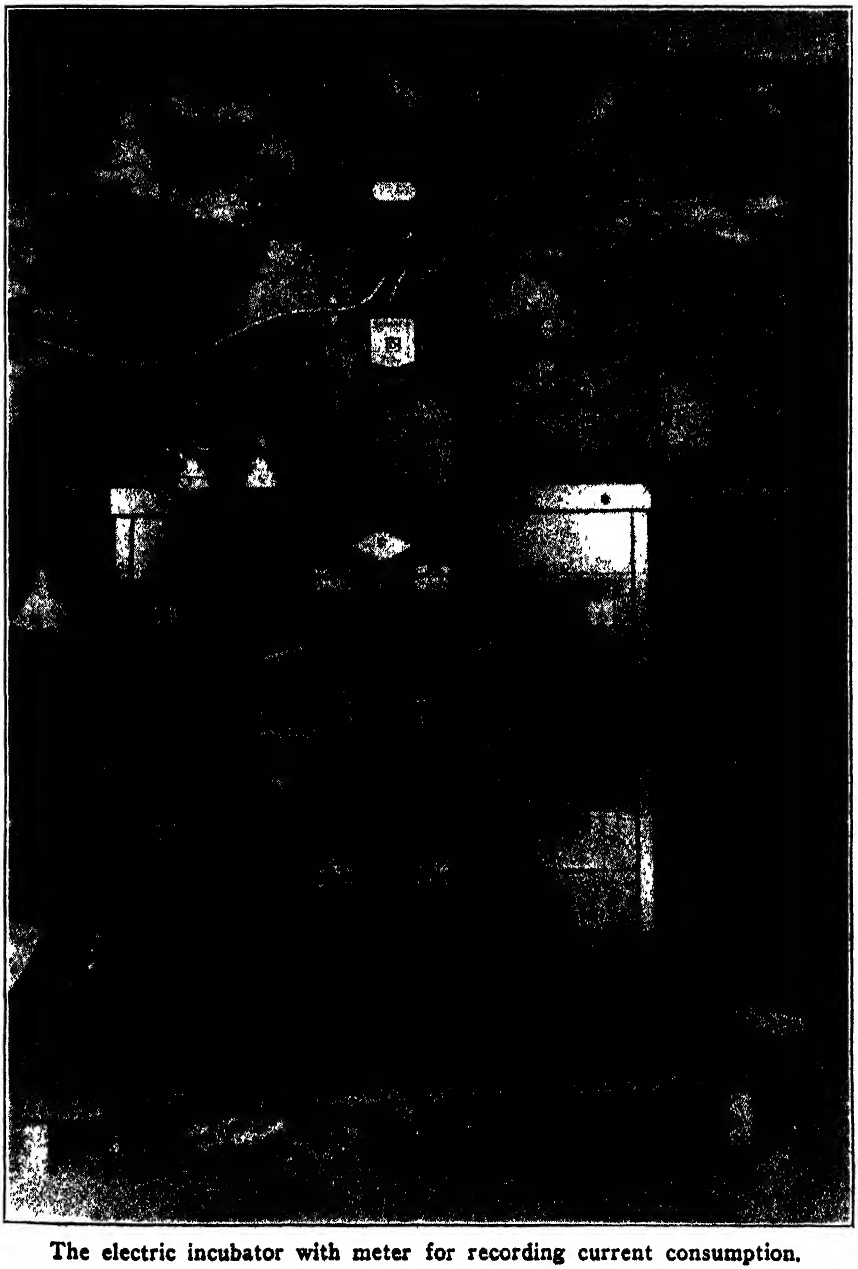
Secure Good Hatches With Little Labor and at Low Cost

O. E. ROBEY, AGRICULTURAL ENGINEERING SECTION

A small farm-size electric incubator was tried out on the Mason-Dansville Rural Electric Experimental Line last spring. The machine was of 620 egg capacity and used electricity for heating and a motor for forced circulation of the heated air and ventilation.

The machine was operated by a family who had had previous experience with kerosene heated incubators. They were asked to keep a record of the time required to care for the machine and compare it with previous experience with other types of machines. The time

actually required during the three hatches run was so small that it was practically negligible. With the exception of the time spent in testing eggs and caring for the chicks, which would be the same for any type of machine, about two or three minutes a day was all that was required.



The electric incubator with meter for recording current consumption.

The fertility of the eggs used was rather low, but the percentage of fertile eggs hatched was very satisfactory. The following table gives the cost of current at 3c per kilowatt hour and the results of the hatches:

Date set--1927	No. eggs	No of fertile eggs	No. hatched	Percent of fertile eggs	Current consumption K. W. H.	Cost at 3c per K. W. H.
April 11	600	479	427	89	119	$3 57
May	585	465	420	90.3	108	3 24
June 3	620	544	482	88.8	118	3 54

CUTTING CORNERS AND CUTTING PROFITS IN SPRAYING

Care Should Be Used in Selecting Means of Reducing Production Costs

BY V. R. GARDNER, HORTICULTURAL SECTION

The money spent for spraying comprises the heaviest cash outlay each year in producing a crop of apples. No commercial grower would discontinue spraying. He well knows that it is impossible. Nevertheless, when the selling price of fruit is low for several successive years, he wonders if it is not possible to widen the margin between selling prices and production costs by cutting corners somewhere.

The spraying bill is usually the item from which he thinks the first and perhaps the greatest cut can be made. The cut may take the form of omitting entirely one or more of the recommended applications, reducing the concentration, leaving out one of the more expensive ingredients from one or more of the applications, or it may take the form of smaller dosage per tree. Before adopting any of these economy measures, it is well to consider carefully what is actually saved in expense, and what such a saving is exchanged for in probabilities of increased exposure to losses from insects and fungi.

Spraying Material and Spray Application Costs

Figures are presented in the second column of Table 1 giving the approximate costs per gallon of standard spray materials as commonly diluted for application. They assume average retail prices in commercial fruit growing districts. Thus concentrated lime sulphur is figured at $.17 per gallon, lead arsenate at $.17 per pound and nicotine sulphate at $13.00 per gallon. When two or more materials are combined in a single application the cost of each gallon as applied to the tree is obtained by adding together their respective gallon costs. Thus

the cost of materials in a summer strength lime sulfur, lead arsenate application is approximately three fourths of a cent ($0.00765 to be exact). The cost of materials for a dormant application of lime sulfur and nicotine sulfate, using the former at its "winter" strength, is approximately three and three-fourths cents per gallon.

Table 1.—Cost of spray materials per gallon as applied in the orchards.

Material	Dilution	Cost per gallon	Application cost per gallon	
Lime sulfur	1-8	$ 0212½	Labor	$ 0088
Lime sulfur	1-40	0042½	Machine operation and depreciation	$.0066
Lead arsenate	1-50	0034	....	....
Nicotine sulfate	1-800	0162	....	....

The fourth column in the table gives estimated costs of making the application. It is assumed that two men and one team will apply six 200 gallon tanks in a 10 hour day. Maintenance and depreciation of the spraying outfit is figured at a dollar an hour. Both labor and machine costs may seem high but it is doubted if they much exceed the averages that actually obtain. In this connection, however, it may be pointed out that if, because of convenience of water supply and efficient management of crew, 10 tanks instead of six can be applied, the labor cost is reduced to a little over a half cent per gallon and the total cost of application to a trifle over a cent per gallon. Though not large, this is an economy well worth striving for because it can be effected not only without increasing the risk of loss from insect and fungus attack but on the contrary it reduces that risk through making possible more timely applications.

Dosage and Concentration

No exact rules can be given for dosage. This naturally varies with the size of the tree, with the stage of leaf growth, with the spreading quality of the spray material, and with a number of other factors. Dosage is adequate only when the entire surface of fruit, foliage, twigs, and limbs is thoroughly covered. Any attempt to limit the amount applied to anything short of complete coverage is attended by too great risk and may be classed as false economy. On the other hand, nothing is gained in control, and both time and material are wasted if trees are oversprayed. Probably 10 gallons per tree constitutes adequate dosage for the average mature apple tree and that is the amount assumed in the computations presented in Table 2.

An extensive series of experiments conducted by the Michigan Experiment Station and reported in detail in Technical Bulletin No. 76 shows conclusively that dilutions of spray materials greater than those in the regularly recommended spraying schedule fail to give satisfactory control during seasons of serious outbreak or infestation. Attempted economy along that line involves much risk and is unwise.

Limiting the Number of Applications

Seven applications are listed in the Michigan spray calendar for apples. These begin with the "dormant" or "delayed-dormant" applica-

tion of an oil emulsion or of the "winter" strength lime sulfur and end with the second brood codling moth spray. It is seldom necessary to make all seven applications in order to obtain satisfactory commercial control of insects and fungi, and very rarely are all seven applications made.

The question is "Which one or ones can be omitted; where can corners be cut with the least risk?"

It is also pertinent to ask how much expense is saved and how much risk is run by each abbreviation of the spraying schedule.

The so-called "pink," the "calyx," the "10-day" or "2-weeks'," and the "August" or second brood codling moth sprays are recognized by practically all Michigan growers as constituting the backbone of the apple spraying schedule, a kind of irreducible minimum that no commercial grower would think of getting along without. This conclusion, if such it may be called, is based on an abundance both of experimental data and of experience, and nothing further probably need be said about those applications except perhaps to note that, at the dosage, price, and speed of application assumed, they entail a total expenditure of $0.92 per tree or $27.60 per acre, assuming a stand of 30 trees to the acre (see Table 2).

Table 2.—Costs of spraying per tree and per acre, assuming 10 gallons per tree per application and 30 trees per acre.

Application	Material	Dilution	Cost per tree	Cost per acre
A. Dormant	Lime sulfur	1-8	$0.365	$10 96
1. Pre-pink	Lime sulfur.	1-40		
	Nicotine sulfate	1-800	0 358	10 75
2. Pink	Lime sulfur	1-40		
	Lead and arsenate	1-50	0 230	6 91
3. Calyx	Lead and arsenate	1-50	0.230	6 91
4. 10-day.	Lead and arsenate	1-50	0 230	6 91
B. 30-day.	Lead and arsenate	1-50	0 230	6 91
5. August	Lead and arsenate	1-50	0 230	6 91
Total (5 applications)			$1 278	$38 39

Importance of the Applications

In the minds of most growers the pre-pink application is almost as important as any of those that follow, for experience has shown that many seasons it is absolutely impossible to control scab without it. Some omit it but they are running altogether too great a risk in doing so. Including it in the schedule adds about 36 cents to the seasons cost of spraying each tree and $10.75 to the cost of spraying each acre.

Just how universally Michigan apple growers make a dormant or delayed season application it is impossible to state. Available evidence, however, indicates that it is rather generally applied. It should be pointed out in this connection that the dormant or delayed dormant application on apple trees is primarily for scale control and scale is not a factor of importance in one out of 25 commercial apple orchards in Michigan. One thorough dormant season application every five or 10 years will control scale in this state. More frequent applications are unnecessary except, perhaps, in a few locations where red mite or leaf

roller have been causing considerable trouble. In these locations a "delayed dormant" oil spray is desirable. It will be noted (Table 2) that this dormant season spray is more expensive than any of the others and in a comparatively large percentage of the orchards now using it a material saving can be effected by its omission without jeopardizing insect and disease control. This is one of the places where it is both possible and practical to cut corners.

The so-called "30-day" application is primarily for codling moth control. Though there may be sections or seasons where or when its inclusion is desirable, it may generally be omitted if the other applications are timely and thorough.

Omitting Nicotine Sulfate from the Pre-pink Application

The relatively high cost of nicotine sulfate has led many growers to raise the question as to the wisdom of leaving this material out of the pre-pink application. Indeed many growers are actually attempting to economize in that way. It is true that nicotine sulfate costs upwards of $1.50 per pint and its inclusion in the pre-pink spray results in adding about 16 cents to the seasons cost of spraying each tree, about $5.00 to the seasons cost of spraying each acre of mature apple trees. However, when it is realized that nicotine sulfate properly applied at that particular time practically guarantees commercial control of the rosy aphid, which in many orchards is the cause of the dwarfing of so much fruit, and that no other application or material has been found really effective against this pest, it certainly seems like false economy to omit it. This is a place where it is possible to slightly reduce expense but there is altogether too great a risk involved to compensate the reduction.

The Key to a Big Saving in Spraying Costs

It has been pointed out that the total cost of five spray applications to average sized fully mature apple tree is about $1.26, or $38.35 per acre. Reduced to a bushel it amounts to just a trifle under 20 cents per bushel for the tree-run product (This statement is based on the fact that records of commercial Michigan apple orchards over a period of years show an average annual yield of 6½ bushels per tree, for mature trees of all varieties). This seems like a rather large cash outlay for what really amounts to one orchard operation, especially in view of the fact that the average value of the tree-run product at the orchard is only about $0.63 per bushel. Is there not some way of reducing it? The answer is yes. In the figures that have been presented it was assumed that the trees were producing average crops, about 6½ bushels annually. There are orchards, however, whose average annual yield has been twice that amount. It costs no more per trees or per acre to spray an orchard that is carrying a 10 or 12 bushel a tree crop than one that is carrying half that amount. Double the yield per tree and per acre and the cost of spraying per bushel is cut in two, though the cost per acre remains the same. Ten cents per bushel for spraying does not seem like a prohibitive figure.

At first, it may sound like something entirely beside the point to say that the way to effect a really big saving in spraying costs is to fer-

tilize the land, but, in nine cases out of ten, that is what it amounts to. Only by so handling the orchard that year after year the trees produce heavy crops can spraying costs be reduced without endangering the grade of the product. Furthermore, it may be pointed out that the same measures that will cut spraying costs in half will effect a corresponding reduction in practically every one of the other production costs.

The question of reducing expenses, of cutting corners in spraying may be summarized in this way; cutting corners by reducing concentration of materials, by decreasing dosage, by leaving out certain materials from certain applications or by entirely omitting certain applications involves risk, too great a risk. Some saving in labor cost may be effected by speeding up the work of application. In most orchards however, costs may be greatly reduced, to a half or even a third of their present figure, by speeding up production, by so handling the orchard that the trees are continually performing at approximately full capacity.

MICHIGAN FARMERS FIND SWEET CLOVER VALUABLE

Rank Growing, Late Maturing Strains Best for Pasture and Soil Improvement

C. R. MEGEE, FARM CROPS SECTION

Sweet clover is rapidly increasing in favor among Michigan farmers as a pasture crop, for soil improvement, and as a cash crop when raised for seed, and in some sections it has been profitably used for hay. There are several strains of sweet clover and, as seeding time approaches, considerable interest is being manifested in the relative value of these different strains.

The ordinary biennial white blossom strain has been used most extensively. It is the one commonly seen growing wild along roadways and in waste places. Several dwarf white blossoms strains have recently come into prominence, of which the Dwarf Grundy County, the Essex Crystal Dwarf, and the Arctic are the leaders at the present time.

On the upland loams and sandy loam soils of Michigan, the dwarf strains yield from 75 to 85 per cent as much top growth or forage and about 80 per cent as much root growth as the ordinary biennial white strain. The dwarf strains are also from ten days to three weeks earlier in maturity.

In choosing a strain for pasture and soil improvement, the amount of growth and the duration of the pasturing period are important considerations. For upland and sandy loam soils the ordinary strain is preferred by many. The dwarf strains have met with some favor on

the heavy fertile, high lime soils of the Thumb section. In most cases where the dwarf strains have been preferred they have been grown for seed. Their earlier maturity, more uniform ripening, and less rank growth make them more desirable for seed production.

Whether farmers who are interested in sweet clover for pasture and soil improvement will accept the dwarf strains remains to be seen. In a number of cases, disappointment has been experienced in the pasturage secured when the dwarf seed was used in place of the ordinary seed.

There are several strains of yellow blossom sweet clover. For general purposes, the yellow blossom strains are quite similar to the dwarf white blossom strains.

Sweet clover is rapidly increasing in favor as a pasture crop for all classes of live stock. One-third of the above field of sweet clover was clipped during early summer and provided excellent pasturage for the sheep. The cattle grazed the unclipped portion.

In securing a satisfactory stand of sweet clover it is important that the seed bed be well prepared and well firmed, that the seed be inoculated and, for best results, the soil should be well supplied with lime. Much of the success with sweet clover comes with a proper understanding of the best methods of handling the crop whether for pasture, seed, soil improvement, or hay. These methods are discussed in detail in Special Bulletin No. 152, a copy of which may be secured from Dean R. S. Shaw, Director of the Experiment Station, Michigan State College, East Lansing.

DEPTH OF PLOWING INFLUENCES YIELDS OF HEMP

Plow Deeper Than Four Inches and Preferably in the Fall to Get Larger Yields

B. B. ROBINSON, FARM CROPS SECTION AND U. S. D. A. BUREAU OF PLANT INDUSTRY CO-OPERATING

For the past three years a few plots of hemp have been grown each year upon land of different depths of plowing. The hemp was cut when the pollen was being liberated. After cutting, it was weighed green and the table gives the yield in pounds of the green hemp calculated in pounds per acre. The seed used in 1925 was of six varieties; a Michigan grown strain was planted in 1926; and, in 1927, the seed was obtained from Kentucky.

In 1925, the results were obtained for each of six varieties upon the different depths, and the figure in the table is an average of the six varieties used. It was impossible to secure fall plowing for the different depths in the last two years, but the results in 1925 indicate that fall plowing is preferable to spring plowing. The four inch plowing consistently gave smaller yields than the six inch plowing but there seems to be little difference between six inch depths and deeper plowings. Four plots disked in 1927 averaged a little more than those prepared by shallow plowing but the disking was well done and deeper than four inches.

Plots which were plowed the same depth were widely separated in 1926 and 1927, but in 1925 they were planted side by side. The hemp was grown in 1925 on a heavy soil of the Brookston series and in 1926 and 1927 a sandy loam or Hillsdale soil was used. The previous plowing was of uniform depth averaging between six and eight inches. It was only in the 10-inch plowing that new soil was noticeably turned up.

Yield of Green Hemp at Different Depths of Plowing, Calculated to Pounds Per Acre.

Year	No. plots	5 in. Disk	4 in. Spring	4 in. Fall	6 in. Spring	6 in. Fall	8 in. Spring	8 in. Fall	10 in. Spring	10 in. Fall
1925	6	....	9540	16772	14367	15469	15959	14310	14552	15002
1926	2	....	8255	....	10541	....	9125	....	....	....
1927	4	19535	18467	....	21552	....	19998	....	19386	....
Average	....	....	12087	....	15487	....	15027	....	16969	....

BEST WHITE PINE SEEDLINGS FOLLOW FALL PLANTING

Obtain Increased Root Development and Resistance to Fungus Diseases

A. K. CHITTENDEN AND P. W. ROBBINS, FORESTRY SECTION

A question frequently asked is "When should white pine seed be planted?"

Should the seed be sown in the fall or are better results obtained by planting it in the spring as is done with the seed of certain other species?

Studies of spring and fall sown white pine seed beds were carried on in the Michigan State College forest nursery in the fall of 1927. The seed was sown in the fall beds in November 1926, and in the spring beds in May 1927. A large number of seedlings from both fall and spring sown beds were weighed and measured. The results are shown in the following table:

Weight and Length of Fall and Spring Sown White Pine Seedlings.

	Wt. in grams of 100 seedlings	Wt. in grams of 100 seedling roots	Wt. in grams of 100 seedling tops	Average length of seedlings in inches
Fall sown seedlings	41 6	19 9	21 7	6 73
Spring sown seedlings	27 8	12 1	15 7	6 19

The seed bed technic used in this experiment did not differ from that ordinarily practiced in the nursery. The beds were four feet wide by sixteen feet long. Each bed used in the study received one bushel of leaf mold as a fertilizer and seven ounces of seed were sown in the bed. The seedlings were screened, with half shade, during the greater part of the summer and were watered during dry weather.

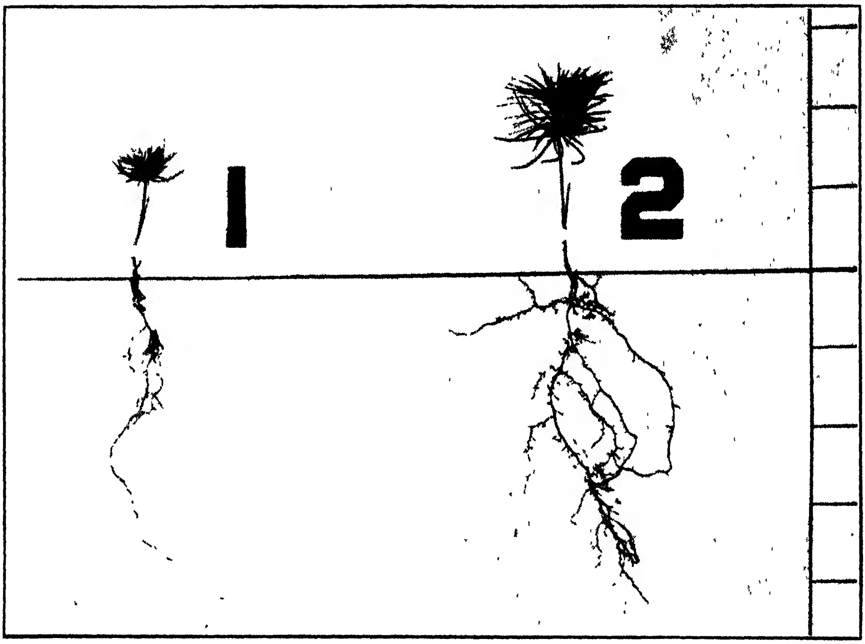
The accompanying picture shows the difference in size of a spring sown seedling and of a fall sown seedling. While the length of roots is the same the fall sown seedling has a bushier, better developed root system, and the top of the plant is also better developed. This is the result of earlier germination and a consequently longer growing season.

Sowing an excess amount of seed per bed in the fall will produce results similar to those secured when the seed is sown in the spring. Care must be taken in computing the number of ounces of seed to be sown per bed or this may happen unintentionally. Over-crowding naturally reduces the size of the seedlings. One hundred and fifty seedlings per square foot is a sufficient density for white pine.

Seed Germinates Slowly

White pine seed is likely to be slow is germinating. If the seed is sown in the spring some of it may hold over for a year before germinating. This results in one and two-year-old seedlings being in the same bed when they should be all the same age. Sorting the small one-year-olds from the larger two-year-olds at the time of lifting is difficult.

Fall sowing of white pine seed is also a safe-guard against severe attacks from damping-off fungi, because the seeds germinate and the stems develop and toughen sufficiently at and just below the surface



One-year-old white pine seedlings. (1) Seedling from spring sown seed. (2) Seedling from fall sown seed.

of the ground before the greatest danger period from damping-off occurs. Early germination also enables the seedlings to crowd out and hold their own with competing weed seed. This is important since labor is the most expensive factor to be considered in the production of seedlings for forest planting.

Best Type For Planting

The best type of seedling for field planting is one with a bushy, fibrous root system. They are the easiest to plant, have roots long enough to get moisture and numerous fibrous roots near the surface to collect the abundant plant food which is available there. These qualities insure a high per cent of success. If the seedlings are left

in the beds until two years old before transplanting the roots will become better developed the second year and the difference between fall and spring seeding is of less importance, although the fall sown seedlings will still be a little larger at the end of the second year. The last of October is the best time to plant white pine seed in the upper peninsula of Michigan and the 10th to the 25th of November in the lower peninsula.

INSULATING VALUE OF BUILDING MATERIALS

Care In Construction Results in Material Savings in Fuel Bills

F. E. FOGLE, AGRICULTURAL ENGINEERING SECTION

The most direct way for a home-owner to cut down fuel costs is to have a warmly built house and burn a smaller quantity of fuel. Likewise the most direct way to reduce feed costs is to house poultry or animals in a warmer building, so that they will require less feed to maintain body temperature and more of the feed can be used for eggs, milk, or meat production, except in the case of meat producing animals on full feed

The means of accomplishing this is by the use of insulating materials.

Every building material offers some resistance to the passage of heat. The one offering the most resistance is the best insulator.

The only difference between "insulation against cold" and "insulation against heat" is that of the direction of the heat flow. Insulating a building against the outside cold is a question of reducing the heat flow from the inside to the outside. In the case of a refrigerator the passage of heat from the outside to the inside must be prevented.

The heat conductivity of a material is a measure of the insulating value of that material, the lower the conductivity the greater the insulating value. The customary measure of the conductivity of a material is the amount of heat in Btu (British Thermal Units) which will flow in one hour through a layer of the material one square foot in area, and one inch thick when the temperature difference between the inside and outside surfaces is 1° F.

The following tables are taken from Letter Circular No. *227*, Bureau of Standards, Washington, D. C.

Table 1 gives the thermal conductivities and weights per cubic foot of various materials which have been tested.

D = Weight in pounds per cubic foot.

C = Thermal conductivity in Btu. per hour, square foot, and temperature gradient of 1° F. per inch thickness. The lower the conductivity, the greater the insulating values.

Table 2 is a more practical table for general use. It gives the con-

Soft Flexible Materials in Sheet Form.

		D	C
Dry Zero.	Kapok between burlap or paper	1.0	0.24
		2.0	0.25
Cabots Quilt	Eel Grass between kraft paper	3.4	0.25
		4.6	0.26
Hair Felt	Felted Cattle Hair	11.0	0.26
		13.0	0.26
Balsam Wool	Chemically treated wood fibre	2.2	0.27
Hairinsul	75% hair—25% jute	6.3	0.27
	50% hair—50% jute	6.1	0.26
Lanofelt	Flax fibres between paper	4.9	0.28
Thermofelt.	Jute and asbestos fibres, felted	10.0	0.37
	Hair and asbestos fibres, felted	7.8	0.28

Loose Materials

		D	C
Rock Wool	Fibrous material, made from rock, also made in sheet form, felted and confined with wire netting	6.0	0.26
		10.0	0.27
		14.0	0.28
		18.0	0.29
Glass Wool	Pyrex glass, curled	4.0	0.29
		10.0	0.29
Sil-O-Cel	Powdered diatomaceous earth	10.6	0.31
Regranulated Cork	Fine particles	9.4	0.30
	About $\frac{3}{16}$ inch particles	8.1	0.31
Thermofil	Gypsum in powdered form	26.0	0.52
		34.0	0.60
Sawdust	Various	12.0	0.41
	Redwood	10.9	0.42
Shavings	Various, from planer	8.8	0.41
Charcoal	From maple, beech, and birch, coarse	13.2	0.36
	6 mesh	15.2	0.37
	20 mesh	19.2	0.39

Semi-Flexible Materials in Sheet Form

		D	C
Flaxlinum	Flax fibre	13.0	0.31
Fibrofelt	Flax and rye fibre	13.6	0.32

Semi-Rigid Materials in Board Form

		D	C
Corkboard	No. added binder, very low density	5.4	0.25
Corkboard	No. added binder, low density	7.0	0.27
Corkboard	No. added binder, medium density	10.6	0.30
Corkboard	No. added binder, high density	14.0	0.34
Eureka.	Corkboard with asphaltic binder	14.5	0.32
Rock Cork	Rock wool block with binder also called "Tuocork"	16.7	0.37
Lith	Board containing rock wool, flax and straw pulp	14.3	0.40

Stiff Fibrous Materials in Sheet Form

		D	C
Insulite	Wood pulp	16.2	0.34
		16.9	0.34
Celotex	Sugar Cane Fibre	13.2	0.34
		14.8	0.34

Cellular Gypsum

		D	C
Insulex or Pyrocell		8	0.35
		12	0.44
		18	0.59
		24	0.77
		30	1.00

Woods (Across Grain)

		D	C
Balsa		7.3	0.33
		8.8	0.38
		20	0.48
Cypress		29	0.67
White Pine		32-	0.78
Mahogany		34	0.90
Virginia Pine		34	0.98
Oak		38	1.02
Maple		44	1.10

Miscellaneous Building Materials

(Data taken from various sources)

	C
Cinder Concrete	2 to 3
Building Gypsum	About 3
Plaster	2 to 5
Building Brick	3 to 6
Glass	5 to 6
Limestone	4 to 9
Concrete	6 to 9
Sandstone	8 to 16
Marble	14 to 20
Granite	13 to 28

ductivity of commercial thicknesses of various materials. In all cases the tabulated values are the average of tests on a number of samples of each material. The insulating value of the materials is given under

column R. Higher figures represent higher resistance to heat passage and greater insulating value.

W = Weight in pounds per square foot
T = Thickness in inches
C = Conductivity in Btu. per hour, per square foot, and per degree
R = 1/C = Resistance or insulating value.

Soft Flexible Materials

		W	T	C	R
Cabots Quilt	Single Ply	0 14	0 35	0 72	1 39
	Double Ply	0 18	0 48	0 54	1 85
	Triple Ply	0 31	0 67	0 39	2 56
Balsam Wool	½ in house insulation, smooth paper	0 16	0 55	0 48	2 10
	½ in refrigerator insulation, creped paper	0 24	0 66	0 41	2 47
	1 in refrigerator insulation, creped paper	0 32	1 13	0 25	4 08
Hairinsul	75% —hair25% jute	0 46	0 55	0 49	2 05
	50% hair—50% jute	0 42	0 51	0 51	1 96
Carinsul	Hairfelt between asbestos paper	0 58	0 60	0 46	2 19
Salamander	Hairfelt paper, asbestos, and cheesecloth, paper between plys—2 ply	0 54	0 61-	0 42	2 40
	3 ply	0 69	0 70	0 36	2 75
Thermofelt	Jute and asbestos	0 42	0 51	0 72	1 39
	Hair and asbestos	0 42	0 63	0 45	2 22
Nyeinsul	Hair felt between cheesecloth, the latter treated with magnesite solution	0 97	0 45	0 82	1 21
Linofelt	½ inch	0 41	0 67	0 42	2 40
Resisto	Similar to Nyeinsul				
	Single	0 56	0 40	0 75	1 30
	Double	0 77	0 62	0 49	2 05

Semi-Flexible Materials

		W	T	C	R
Flaxinum		0 61	0 56	0 56	1 80
Fibrofelt		0 66	0 58	0 56	1 80

Stiff Fibrous Materials

		W	T	C	R
Insulite	Wall board	0 66	0 49	0 69	1 46
	Insulation board	0 80	0 56	0 60	1 67
Celotex	Building board	0 58	0 47	0 72	1 38
	Railroad Insulation board	0 64	0 58	0 59	1 71

Plaster and Wall Boards

		W	T	C	R
Gyplap	Gypsum between layers of heavy paper	2 23	0 50	2 6	0 38
Sheet Rock	Gypsum mixed with sawdust between layers of heavy paper.	1 97	0 39	3 6	0 27

Approximate Fuel Savings in Dwelling Houses

Expressed in per cent of fuel which would have been required for similar house without insulation or weather stripping.

	Saving
No insulation—weather stripped	15 to 20%
Same—with double (storm) windows	25 to 30%
½" Insulation—not weather stripped	20 to 30%
½" Insulation—weather stripped	About 40%
½" Insulation—with double windows	About 50%
1" Insulation—not weather stripped	30 to 40%
1" Insulation—weather stripped	About 50%
1" Insulation—with double windows	About 60%

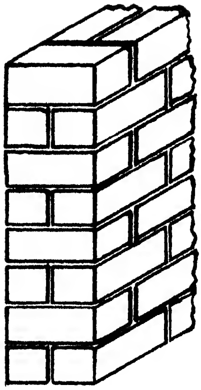
Expressed in per cent of fuel which would have been required for similar house without insulation or weather stripping.

	Saving
With double windows, no insulation	10 to 15%
½" Insulation only	25 to 35%
½" Insulation—with double windows	40 to 45%
1" insulation only	35 to 45%
1" Insulation—with double windows	50 to 55%

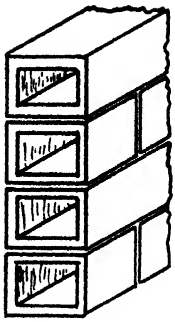
The following table gives heat transmission for exterior walls of clapboards:

Heat Transmission for Walls of Clapboard.

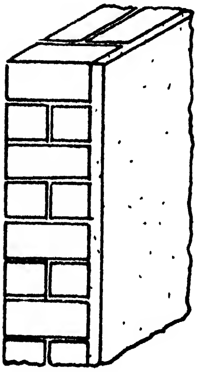
Construction	B. T. U. per deg. Fahr Difference 15 mi. per hr wind
Clapboard on studs	0 62
Clapboard on studs, lath and plaster	0 48
Clapboard, paper, studs, lath and plaster	0 34
Clapboard, studs, 1" sheathing	0 57
Clapboard, sheathing, studs, lath and plaster	0 37
Clapboard, paper, sheathing, studs, lath and plaster	0 30
Clapboard, studs, Brick fill	0 40
Clapboard, studs, brick fill, papered	0 36
Clapboard, studs, brick fill, lath and plaster	0 31
Clapboard, sheathing, studs, lath and plaster with sawdust fill	0 21
Clapboard, paper, sheathing, studs, lath and plaster with sawdust fill	0 15



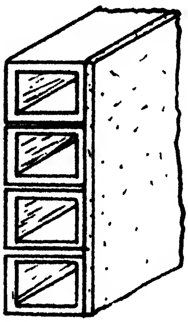
PLAIN BRICK



PLAIN HOLLOW TILE



BRICK PLASTERED ONE SIDE



HOLLOW TILE PLASTERED ONE SIDE

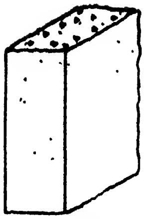
Plain Brick
9″ wall 0.36
18″ wall 0.22

Brick Wall Plastered on One Side
9″ wall 0.30
18″ wall 0.20

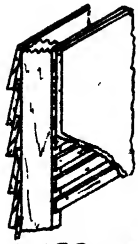
Plain Hollow Tile
4″ wall 0.39
6″ wall 0.32
8″ wall 0.25

Hollow Tile Plastered One Side
4″ wall 0.33
6″ wall 0.29
8″ wall 0.23

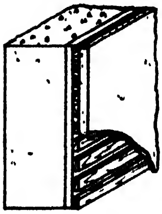
In the various types of wall construction shown in the cuts, the B. T. U. losses transmitted per square foot per hour per degree temperature difference between inside and outside air in fifteen mile wind is given below. The lower the heat loss the greater the insulating value.



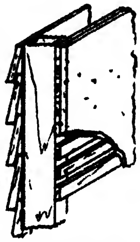
PLAIN CONCRETE



CLAPBOARDS STUDS LATH AND PLASTER



CONCRETE, FURRED, LATHED AND PLASTERED



CLAPBOARDS, PAPER STUDS, LATH AND PLASTER

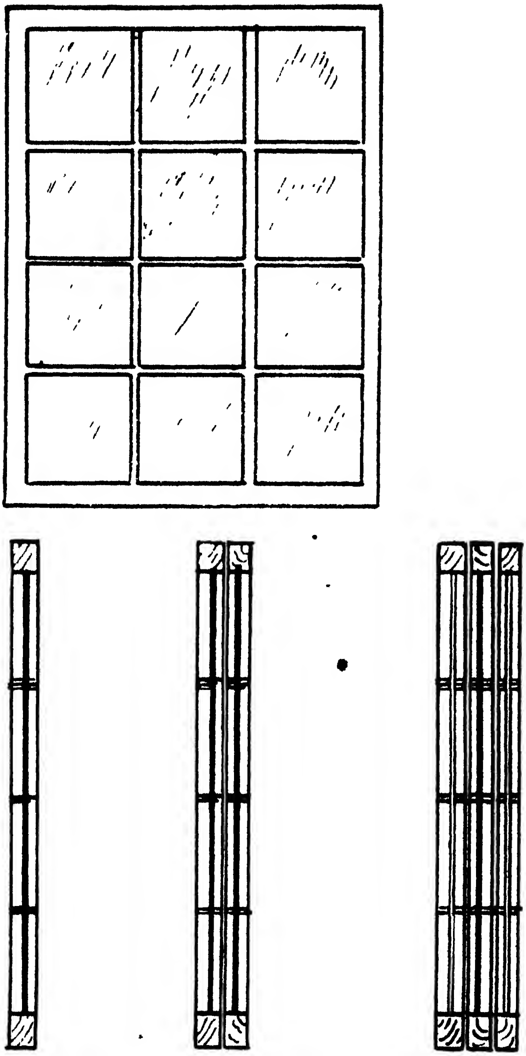
Plain Concrete Wall
2" wall 0.81
4" wall 0.66
8" wall 0.40

Concrete, Furred, Lathed and Plastered
4" wall 0.30
8" wall 0.26
12" wall 0.23

Clapboards, Studs, Lath and Plaster, 0.48

Clapboards, Paper, Studding, Lath and Plaster, 0.34

In the various types of wall construction shown in the cuts, the B. T. U. losses transmitted per square foot per hour per degree temperature difference between inside and outside air in fifteen mile wind is given below. The lower the heat loss the greater the insulating value.



WINDOW SASH
SINGLE, DOUBLE AND TRIPLE

Single Window 1.126
Double Window 0.450
Triple Window 0.281

CARE NOW NECESSITY IN FLOCK MANAGEMENT

Conditions Confronting Sheep Raisers Make Better Practices Essential

BY G. A. BROWN, ANIMAL HUSBANDRY SECTION

For several years, sheep have been one of the most profitable classes of farm live stock. During each of the past two years, many writers have predicted that sheep were due to enter a period of lower prices resulting in less remunerative returns to the producer. The high market price paid for lambs has deferred this period, owing to the fact that ewe lambs were marketed rather than being kept for breeding purposes. In the meantime, there has been a scramble on the part of men who desire to engage in the sheep business to purchase breeding ewes. As a result many old ewes which should have gone to the shambles are still on the farms producing lamb.

Many unprofitable ewes have also been retained, owing to the remunerative prices received for lambs and wool. During the last year indications are that considerable numbers of ewe lambs have been retained for breeding purposes resulting in a larger number of ewes on the farms and ranges than has been the case for several years. It is probable, therefore, that we will see during the next two or three years declining prices for lambs. Personally, I believe that sheep will continue to be profitable in the hands of the thoughtful farmer whose farm is adapted to sheep.

However, declining prices will mean that the man who has not exercised reasonable care in culling his flock and is not practicing efficient methods will find the business unprofitable. It is my judgment at this time that if prices are going to be maintained and the business continue as profitable as we would like to see it that every producer should, during the coming season, give careful consideration to the culling of his flock and improve his methods at every possible point.

Ewes Should Be Culled

The culling of the flock should start this coming spring. Lambing and shearing time offers the most favorable opportunity for the detection of the unprofitable individuals in the flock. A careful record should be made of the weight, length of staple, and quality of each ewe's fleece, and each ewe not producing at least eight pounds and preferably ten pounds of wool of staple length and at least one-quarter to three-eighths blood quality should be marked for disposal as soon as her lambs are weaned or at once if she is not in lamb.

Shearing time when the sheep are being handled also provides an excellent opportunity to check up on the age of the flock. Any ewe whose teeth are becoming long, spreading apart, and setting forward

at a marked angle to the jaw should be marked for disposal. Careful note should also be made of the milking ability of the different members of the flock. Those ewes which are not good milkers, or whose lambs are unthrifty, failing to grow and thrive as the majority of the lambs do, should also be disposed of.

In many flocks the ewes may be all right as far as the above particulars are concerned. Still there will be some individuals that lack the most desired conformation and fleshing properties. While we desire considerable size in the breeding ewe, the rather upstanding, leggy, long necked individual is not a desirable kind to keep. In the ewes to be kept we should seek greater depth and breadth of body; good spring of rib; deep, wide quarters and chest; short neck; and only moderate length of leg.

First Prize Pen of three Shropshire Rams, 1927 Michigan State Fair.

Extreme right—First Prize and Reserve Champion Shropshire Ram.

From the standpoint of more efficient methods of handling, many producers fail in their efforts because they do not dock and castrate their lambs. This results in a much lower price for the lambs in the fall of the year, and the flock of lambs in which there are a number of ram lambs will not take on the weight or finish that they otherwise would.

Parasite Control Important

Failure to control parasites is also a frequent cause of light, inferior lambs which fail to bring a remunerative price. Methods of controlling parasites may be obtained from the county agricultural agent or by writing the Michigan State College.

Summer pastures and care should also receive consideration. Where

one does not have an abundance of grazing or pasture land, provision should be made to supply supplemental pastures during the late summer. Where pasture needs can be planned a year in advance, a small area of sweet clover in connection with June grass pastures offers the best solution of this problem. Where this cannot be done, a small acreage of Dwarf Essex rape sown in the spring so that the lambs can be turned in after weaning or by mid-summer will do much to make extra pounds and put the lambs in higher market condition.

Efficient Practices Profitable

I want to reiterate that I have every faith in the future of the sheep industry for the man who has a farm adapted to sheep, who is interested in their care, and who will adopt efficient methods. I feel, however, that we will have declining prices and that these should be prepared for and possibly postponed by careful culling of the flock and more efficient methods of feeding and production. The man about to engage in sheep raising should be very careful in his purchases, should buy young or middle aged ewes only, of good form and individuality, heavy shearing qualities and should use only the best pure bred rams.

PRODUCTION TEST OF COMMERCIAL SUGAR BEET SEED

Results of a Test of Various Brands of Commercial Sugar Beet Seed

FARM CROPS SECTION, M. S. C. EXP. STA., AND OFFICE OF SUGAR-PLANTS INVESTIGATIONS, U. S. D. A. COOPERATING. J. G. LILL IN CHARGE

This test was conducted at the Michigan State Experiment Station at East Lansing, Michigan, and at Saginaw, Michigan, during the season of 1927, and this report gives the results secured under the field, soil, and seasonal conditions surrounding it.

Each brand of seed was planted on fifteen different plots, or on five plots in each third of the test. One complete third of the test was planted near Saginaw, Michigan, April 29. The other two-thirds of the test were planted on the State Experiment Station farm at East Lansing, Michigan, May 5. One-third of the test was planted on a heavy soil of the Brookston type and two-thirds on a lighter and more variable soil.

The seasonal conditions were adverse and unusual. Abnormal precipitation in May and September and subnormal precipitation during June, July, and August prevented the sugar beets grown from each brand of seed from developing evenly and normally.

The results given in this report were obtained by a compilation of the fifteen different determinations made for each brand of seed included

in the test. One brand of seed (*J. Zapotil*) was planted in every third plot as a control to check upon variations caused by changes in the soil fertility or other factors. The variations in the stand, yield, per cent sucrose, purity coefficient, and sugar produced per plot shown by this control have been fully considered in the preparation of this report.

The results herein given have been reduced to a direct comparative basis by approved statistical methods. The significance of the difference between the results given for any brand of seed and the results given for the control has been determined by "Students Method" of statistical analyses. No brand of seed included in this test is shown to be significantly different from the control unless so indicated by the symbol following the result secured with that br^nd of seed. It is entirely possible for a brand of seed to give results which are significantly different from the control in one respect and not in others.

In Table II, the colums will not cross check. Each figure given in this table is the result of the compilation of the fifteen original determinations. The amount of sugar produced per plot was determined for each of the fifteen different plots for each of the various brands of

Table 1.—Shows the number of times that the results secured in the fifteen different determinations made for each brand of seed tested, equalled or exceeded the results secured from the control grown beside it.

Field No	Designation of brand	In stand per A	In yield per A.	In sucrose per cent	In purity coefficent	In sugar per A
39	Belotzerkov I	14	12	3	6	12
29	R. & G Old Type	11	14	2	8	13
45	Horning	11	11	4	8	12
34	Otto Dippe	9	12	4	4	10
26	Ivanovsk IV	11	10	7	6	9
10	Hilleshog	10	7	7	6	7
28	Ivanovsk V	10	8	6	5	9
2	G D W. I	9	8	10	5	7
9	Zapotil	8	10	10	8	11
44	R & G. Pioneer	8	7	12	10	8
30	Dobrovice	7	8	9	7	8
13	August Knoche "E"	12	11	0	4	9
27	Hartman's Glostrup	12	12	5	4	10
38	"Mazel" brand	11	9	13	7	8
16	R. & G Normal	7	7	6	8	7
46	E Z. Z C	11	5	14	12	6
17	R & G Normal	6	9	4	4	9
35	U D. Y C Z	10	6	11	4	7
3	Schreiber's "S S"	7	8	5	6	8
1	Strube	11	4	11	8	6
12	August Knoche "E"	10	6	4	6	6
11	Hilleshog	12	6	6	2	8
25	Schreiber's "S. K W"	8	7	7	5	8
42	Verchmatchka II	12	4	11	6	6
40	Erhard Frederiksen	5	8	9	6	8
36	Uladovsk III	8	6	8	7	6
47	"Granum" brand	11	4	14	6	6
15	August Knoche "Z"	8	6	10	6	5
31	R & G Extreme Pioneer	9	6	8	9	5
24	Delitzscher	7	5	10	7	6
32	Vilmorin	6	5	4	3	5
43	Canadian grown	6	4	5	7	4
20	Neo Maximale	10	5	14	5	5
22	Martin (Ceres)	8	4	6	7	4
19	Buszcynski Productive	10	5	11	3	4
37	Sebline	6	3	12	10	3
18	Buszczynski Productive	6	5	13	6	5
14	August Knoche "Z"	4	1	10	6	1
41	Buszczynski Productive Super Elite	6	1	13	7	3
21	Neo Maximale.	7	1	11	6	2
23	Royal Dutch Pedigree (Kuhn)	6	2	12	7	2
33	Rimpau Original.	4	3	11	3	3

Table 2.—The results of the test, showing the stand, the yield, the per cent sucrose, the purity coefficient, and the pounds of sugar produced per acre, for the beets grown from each brand of seed tested.

Field No	Brand designation and source (P—sample from producer)* (C—from commercial seed)*		Stand per acre	Yield per acre T.	Sucrose content per cent	Purity factor per cent	Pounds sugar per A.
39	Belotzerkov I	P*	21160B	10 623C	15 63C	86 63	3298A
29	R. & G Old Type	P	20142	10 478C	15 73C	86 75	3271A
45	Hornirg	C*	22179A	10 275B	15 97	86 26	3263A
34	Otto Dippe	C	19856	10 425C	15 84A	86 38	3260A
26	Ivanovsk IV	P	21631B	9 906	16 13	86 28	3176
10	Hilleshcg	C	20868	9 657	16 18	86 38	3089
28	Ivanovsk V	P	20431	9 621	16 20	86 66	3084
2	G D. W. I	C	20287	9 399	16 33	86 17	3036
9	Zapotil	C	19898	9 387	16 37	87 34	3035
44	R & G Pioneer	P	19540	9 249	16 59B	87 12	3031
30	Dobrovice	P	18897	9 334	16 38	86 62	3030
13	August Knoche "E"	C	20469B	9 940B	15 39D	85 71A	3026
27	Glostrup	C	20736	9 637	15 82A	86 15	3021
38	"Mayzel"	P	21002A	9 185	16 66B	87 01	3018
16	R & G Normal	P	19360	9 422	16 12	86 77	3016
46	E Z Z. C	P	21108	8 941	16 98D	88 00B	3013
17	R & G Normal	C	18766	9 391	16 14	86 17	3008
35	UDYCZ	P	20487	9 004	16 72C	86 58	3002
3	Schreiber's "S. S"	C	19050	9 447	16 01	86 55	2979
	Average of 375 Controls	P	19360	9 288	16 214	86 97	2977
1	Strube	C	20332	9 106	16 50	86 98	2976
12	August Knoche "E"	P	20202	9 419	15 93	86 25	2969
11	Hilleshog	P	21310B	9 203	16 16	85 77D	2948
25	Schreiber's "S K. W"	C	20285	9 256	16 10	86 63	2943
42	Verchiatchka II	P	21052A	8 932	16 66A	87 34	2925
10	E Frederiksen	C	18388	9 072	16 26	86 73	2912
36	Uladovsk III	P	19116	9 086	16 06	86 90	2902
47	"Granum"	P	20541	8 561A	16.96D	86 44	2875
15	August Knoche "Z"	C	19283	8 748	16 33	86 47	2833
31	R & G Extreme Pioneer	P	18944	8 761	16 31	87 01	2829
24	Delitzscher	C	19261	8 690A	16 33	86 76	2825
32	Vilmorin	P	17993	8 997	15 74A	85 59	2805A
43	Canadian grown	P	19230	8 686	16 17	86 78	2789
20	Neo Maximale	P	20813	8 188B	16 78D	87 00	2720A
22	Martin brand (Ceros)	P	19060	8 492B	16 14	86 64	2718B
19	Buszczynski's Productive	C	21009A	8 236C	16 49	85 88A	2697B
37	Sebline	P	19168	8 018D	16 79D	87 86	2644A
18	Buszczynski's Productive	P	19385	8 013B	16 57B	86 28	2634B
14	August Knoche "Z"	P	17318A	7 999D	16 61A	86 77	2610D
41	Buszczynski's Productive S. E	P	18676	7 606D	17 14D	88 05	2561D
21	Neo Maximale	C	18982	7 667D	16 80C	87 18	2526D
23	Kuhn's Royal Dutch	P	18708	7 749D	16 44	86 40	2502D
33	Rimpau Original	P	16705B	7 656D	16 44	86 15	2476C

Note: All analyses considered in the preparation of this report were made by the Chemistry Section of the Agricultural Experiment Station.

seed and these fifteen determinations compiled. The result secured in this manner will not check exactly with the amount of sugar per acre indicated by the figures given in the yield and sucrose per cent columns.

Explanation of Symbols:

Where the results secured in this test differ from the results given by the control brand of seed used, the significance of the difference is indicated by symbols. The significance is stated in odds of a certain amount to 1 that the difference between the result given and the control was not due to chance alone but was therefore, probably due to some quality of the seed tested.

No symbol	Odds about even
A	Odds at least 30 to 1
B	Odds at least 100 to 1
C	Odds at least 500 to 1
D	Odds at least 1000 to 1.

As the success of this test depends to a large extent upon the co-operation of the sugar beet seed producers, the American representatives of the seed producers, and the various sugar companies operating throughout the United States, this opportunity is taken to state our appreciation of the excellent co-operation received from these various sources. As this test will be conducted again in 1928, it is also desired at this time, to request the various agencies to arrange to submit five pound samples of the various brands of seed for use in the 1928 test. Samples submitted must be plainly labelled with the brand designation, the source of the seed, and the name of the agency submitting it.

EXPERIENCE WITH ELECTRIC STOVES

Found to be Both Practical and Economical in Operation

O. E. ROBEY, AGRICULTURAL ENGINEERING SECTION

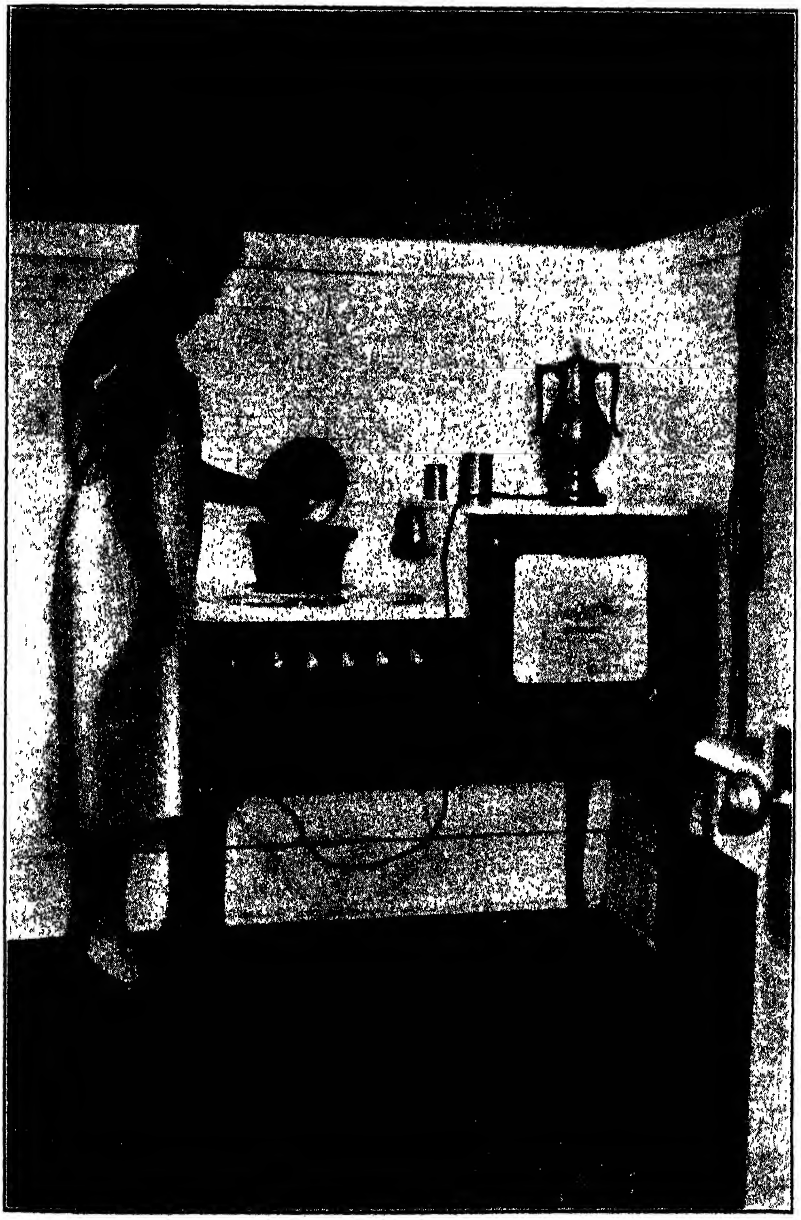
Three electric stoves are now being used on the Mason-Dansville Rural Electric Experimental Line. Observations are being made and records are being kept to determine, if possible, the practicability of electricity for cooking and baking on the farm.

These stoves have not been operated long enough to secure very conclusive data. The results so far show that, where a satisfactory rate can be secured, this method of cooking is quite economical.

One of the stoves is a full automatic, having a clock to turn on the oven or an appliance at a prescribed time and a thermostat to turn the oven off when the heat desired has been reached. The other two stoves do not have the clock control but do have the thermostatic control on the ovens.

The concensus of opinion of the operators is that the electric stove is very convenient, does not radiate much heat in the summer time, is quicker to respond and much cleaner than kerosene, wood, or coal. A great deal of time is saved in the operation of the electric stove because it does not have to be supplied with fuel. All operators have commented on the performance of the electric oven. While a little time is required for the various things cooked, yet, when this is once learned, baking becomes practically automatic.

One of the stoves, No. 1, has not been used for all the baking and cooking. This stove has served in about the same role as a kerosene stove when used to supplement the range in warm weather. This stove



One of the stoves used in the tests on the Mason-Dansville Experimental Show.

was installed April 6, 1927, and has done the cooking and baking for a family of seven.

Stove No. 2 was installed March 24, 1927 and has been used for practically all the cooking and baking for a family of six.

Stove No. 3 was installed November 1, 1927 and has been used in conjunction with a wood range. Perhaps one-half of the cooking has been done electrically. This range is serving a family of four.

A number of power companies either give a special rate for the range or else so arrange their schedule that, when there is a large consumption of current, a cheaper rate will automatically be secured. On the Mason-Dansville line the rate is five cents for the first 30 kilowatt hours and three cents per kilowatt hour for any amount above 30 kilowatt hours, plus a $3 monthly service charge. Since the lights usually consume the first 30 kilowatt hours, stoves, motors, and other appliances can be figured on the three cent rate.

The following table gives the amount of current consumed between the date of installation and December 17, 1927.

Stove	Date installed 1927	Time operated	Total kilowatt hrs used	Total cost at 3c per kilow't hr	Average cost per mo
No 1	April 6	8 mo 11 da	706	$21 18	$2 52
No. 2	March 24	8 mo 23 da	1030	30 90	3 47
No 3	November 1	1 mo 17 da	54	1 62	1 16

No exact figures are available to show what it cost to do the cooking in these homes previously, but the operators believe that the cost for electricity is no more than for kerosene, wood, or coal, especially when the time of handling the fuel is considered.

One of the greatest objections to the electric stove is its first cost. The above stoves varied in price from $140 to $175. In order to make the electric stove economical to operate, additional equipment should be provided. Percolators, toasters, pan cake griddles, electric fireless cookers are all more economical to operate than doing the same work on an open burner. Saucepans, kettles, and other utensils used should cover the burner completely so as to absorb a maximum amount of heat.

The oven on the electric stoves is usually very efficient. It can be well insulated and the current is turned on only a small part of the baking period. The most of the baking is done with stored heat or heat that would otherwise be lost in an oven poorly insulated. By means of the thermostat the oven is kept at a predetermined temperature.

All of the stoves have three burners and an oven. These stoves consume about 6,000 watts each if all the burners are on. It is necessary to have a larger transformer and heavier wires from the power line to the house than are ordinarily installed in order to operate stoves of this type. Three wire 110-220 volt service to the house is desirable.

GROWTH OF CONIFERS MEASURED IN UPPER PENINSULA

Care in Lumbering Insures Seed Trees to Restock Cut Over Areas

P. W. ROBBINS, FORESTRY SECTION

Growth studies of white spruce and balsam fir were carried on during the past summer near the Dunbar Forest Experiment Station in Chippewa County. The data were collected in Section 1, Township 45 North, Range 1 East.

The soil in this location is a rocky, sandy loam, graduating to rocky sand on the highest ground and to a heavy clay on the lower portions. The area has a rolling to flat topography with poor drainage. The average rainfall for Chippewa County is 29.96 inches. The average snowfall per year in 70.2 inches. The study was based on the analysis of 575 white spruce and 552 balsam fir trees.

The predominating specie is spruce with balsam fir a close second. Balm of Gilead and willow are the associate species on the low moist lands and paper birch and white pine the associate species on the well drained soils.

Rate of Growth

The balsam fir grows at about the same rate as the white spruce but it does not live as long. It reproduces better in the forest as it is a more prolific seeder and the seedlings are more tolerant of shade. Spruce seedlings prefer a shady site but cannot stand the same amount of shade that balsam fir can. Balsam fir seeds germinate well in duff and litter while white spruce seems to prefer a more mineral soil.

The white spruce is more valuable than the balsam fir. In this locality white spruce sells for $8.00 per cord and balsam fir for $5.00 f. o. b. or corded on the bank if in the vicinity of the connecting waters of the Great Lakes.

Balsam fir, because it is the less valuable species, is not cut to as small a diameter limit as the white spruce. This is a poor policy if the land is to be allowed to produce another crop of trees, because balsam fir trees left standing will restock the area and they are not so valuable as the spruce. Land which is too stony for agricultural purposes in this locality should be kept in tree crops.

The following tables give data from a reproduction study carried on at the same time as the study of diameter and height growth. Table No. 2 gives the amount of reproduction per acre, based on an average of five sample plots located in the NW ¼ of the NW ¼ of Section 7, Township 45 north, Range 2 east. The area covered by these plots has not been burned over since the area was logged five years ago. The soil is very rocky sandy loam to loamy sand, typically

The following table gives the average rate of growth in diameter breast high, four and a half feet above the ground, and height of white spruce and balsam fir.

Table 1.—Growth in diameter and height of white spruce and balsam fir.

Age	Diameter in inches at 4½ feet above ground		Height in feet	
	White spruce	Balsam fir	White spruce	Balsam fir
10	4	6	7	7 5
15	1	1 4	11	12
20	2 1	2 2	16	17
25	3 0	3 2	23	23
30	4 1	4 3	30	29
35	5 2	5 5	36	35
40	6 3	6 6	42	40
45	7 2	7 5	46	44
50	8 4	8 6	49	46
55	9 1	9 2	51	48
60	9 8	9 7	53	49

non-agricultural. Willow and cherry brush are present over part of the area.

Table 2.—Trees on an average acre of land cut-over five years ago.

Species	Number of small trees per acre	Average height, inches	Trees left in logging, per acre	Average diameter of trees left in logging, inches
White spruce	1544	38 2	10	3 3
Balsam fir	1520	45 1	4	1 9
Poplar	78	20 5	20	1 7
White pine	10	14 0		
Maple			22	2 2
Oak			4	5
Birch			22	1 8

Table No. 3 gives the average amount of reproduction per acre, based on three plots located in the NW ¼ of the SE ¼ of Section 1, Township 45 north, Range 1 east. This area was logged over three years before the study was made and has not been burned over since

Table 3.—Trees on an average acre of land cut-over three years ago.

Species	Number of small trees per acre	Average height, inches	Trees left in logging, per acre	Average diameter of trees left in logging, inches
White spruce	10	12.5	16	5.0
Balsam fir	446	16.7	33	2.5
Poplar	323	30 6	13	4.0

logging. The soil is sandy loam and rocky sand on the higher ground with the lowest portions running into clay. It is too stony for good agricultural land. Poplar brush is present over some of the area.

From the above tables it is evident that cut-over pulpwood lands in this locality will restock themselves from natural seeding of their own accord. These plots are fairly well stocked in five and three years respectively after logging operations were over. They give an idea of the results which can be obtained toward producing a future crop if care is practiced at the time of and after logging, and if fires are kept out.

Seed Trees Needed

A new crop of trees will be assured on these pulpwood lands if care is taken during the logging operations to prevent unnecessary destruction of small coniferous seedlings already on the ground and if a sufficient number of healthy white spruce seed-bearing trees are left per acre. All poplar and paper birch trees on the area should be cut at the time of logging and fires must be kept out.

The new forest will come from trees left on the area which have not reached a merchantable diameter at the time of logging, seedlings and reproduction already established on the area, the seed which falls from the cones of the spruce and balsam at the time of logging, and from the seed bearing trees left on the area. The wind blows the small seeds over the entire area and they germinate readily on the mineral soil exposed by the logging operations.

White spruce seed trees should be left if possible in preference to balsam fir because they live longer than balsam fir, grow at about the same rate and bring a better price on the pulpwood market.

Raising white spruce for pulpwood in this part of the upper peninsula of Michigan will pay because there is plenty of cheap land unfit for agricultural purposes, and because water and railroad transportation facilities to the nearby pulp and paper mills are good. The nearby pulp and paper mills furnish an adequate market and the large investments in these plants assure the pulpwood producer a market in the future.

RECONSTRUCTION OF FOREST COVER BASED ON SOIL MAPS

Replacement of Original Forest May Depend Upon Study of Soil Types

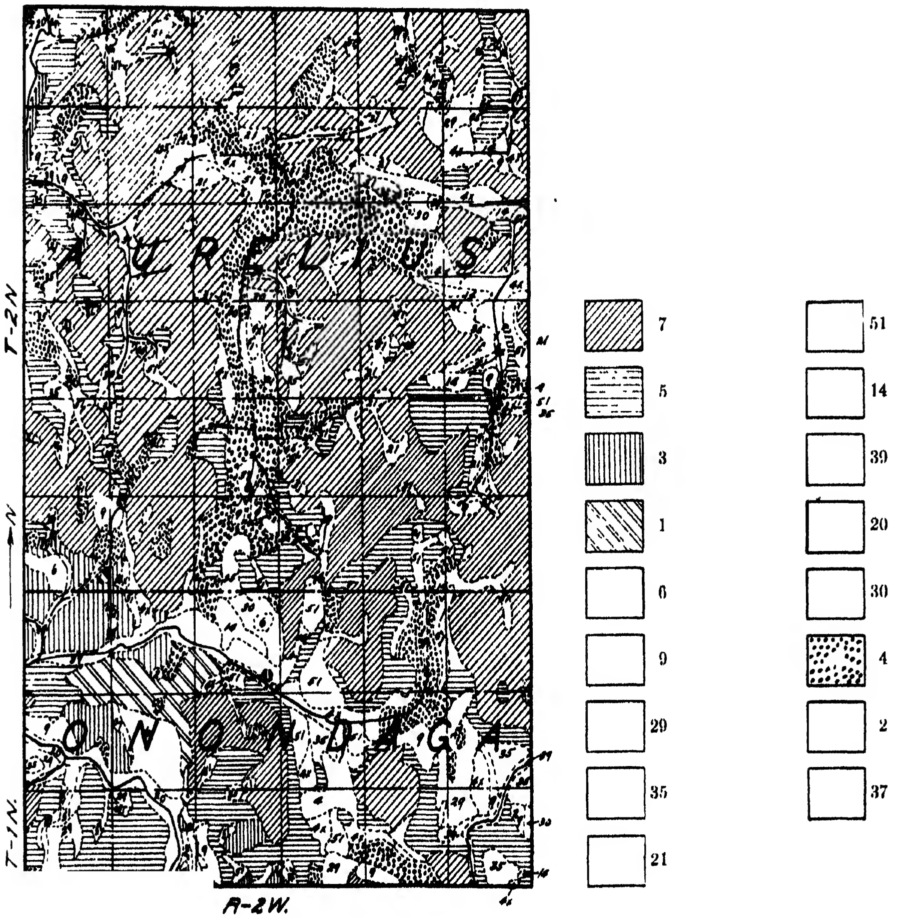
BY J. O. VEATCH, SOILS SECTION

The early settlers in the forested region of the eastern part of the United States used the tree or forest growth as a basis for determining differences in soil or land. In many instances, this relationship constituted a basis of classification according to value and use. In Michigan for example, "hardwood land" implied the better soil for general farming, "pine land" the poorer.

Botanists and ecologists, soil scientists and geologists have also observed more or less close correlations between distribution and habit of growth of native vegetation and soil, and have recorded their observations for numerous localities in scientific literature. That correlations and inter-relationships do exist therefore can be accepted without argument, since they are substantiated by observation, and should exist upon theoretical grounds.

The general character of the climate has determined the regional nature of the forest growth and other vegetation, and, according to modern concepts, has likewise determined the regional character of the soil; while, locally, differences in moisture and temperature which have been a cause of variations in native vegetation have also been the natural factors, in association with parent soil material, which have caused local variations in soil. Since the plant derives its water and nutrients mainly from the soil, it follows that differences in these factors in the soil must effect corresponding differences in individual plants or in associations of plants.

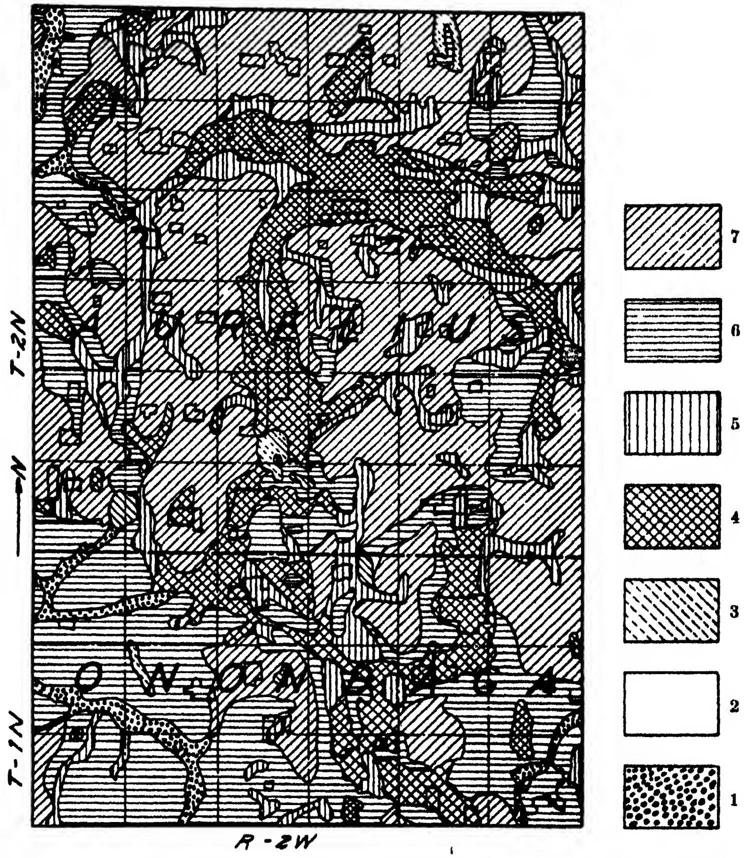
That many of the correlations between soils and forest growth which have been made have failed to have a general application and have proved erroneous in some respect does not entirely invalidate them. In some instances, correlations have been attempted on the assumption that a geological formation is the equivalent of a soil which is not generally true. Other correlations have been based upon single characteristics or conditions of the soil such as reaction, lime content, potash content, or moisture, or upon the composition of some one layer rather than upon the whole soil profile, or total depth to which plant roots penetrate, or without proper consideration of the underlying horizons which may affect chemical and physical relationships of surface horizons. The **soil type,** if ideally established, should represent the complex of all of the soil factors which affect the growth of vegetation under natural conditions, and it seems logical therefore that relationship distribution, in particular, should be worked out on this basis.



Soil map of Aurelius and a part of Onondaga townships, Ingham County, Michigan. (From the Soil Survey of Ingham County, Michigan (unpublished) by Michigan State Agricultural Experiment Station and U. S. Bureau of Soils cooperating).

LEGEND FOR SOIL MAP. FIG 1.

7 - Miami loam
5 - Hillsdale sandy loam
3 - Fox sandy loam
1 — Fox loam
6 — Plainfield sand
9 Bellefontaine gravelly sandy loam
29 - Bellefontaine sandy loam
35 - Coloma sand
21 - Conover loam
51 — Brookston loam
14 — Newton sandy loam
39 — Griffin loam
20 — Genesee loam
30 — Berrien sandy loam
4 - Carlisle muck
2 — Greenwood peat
37 Rifle peat

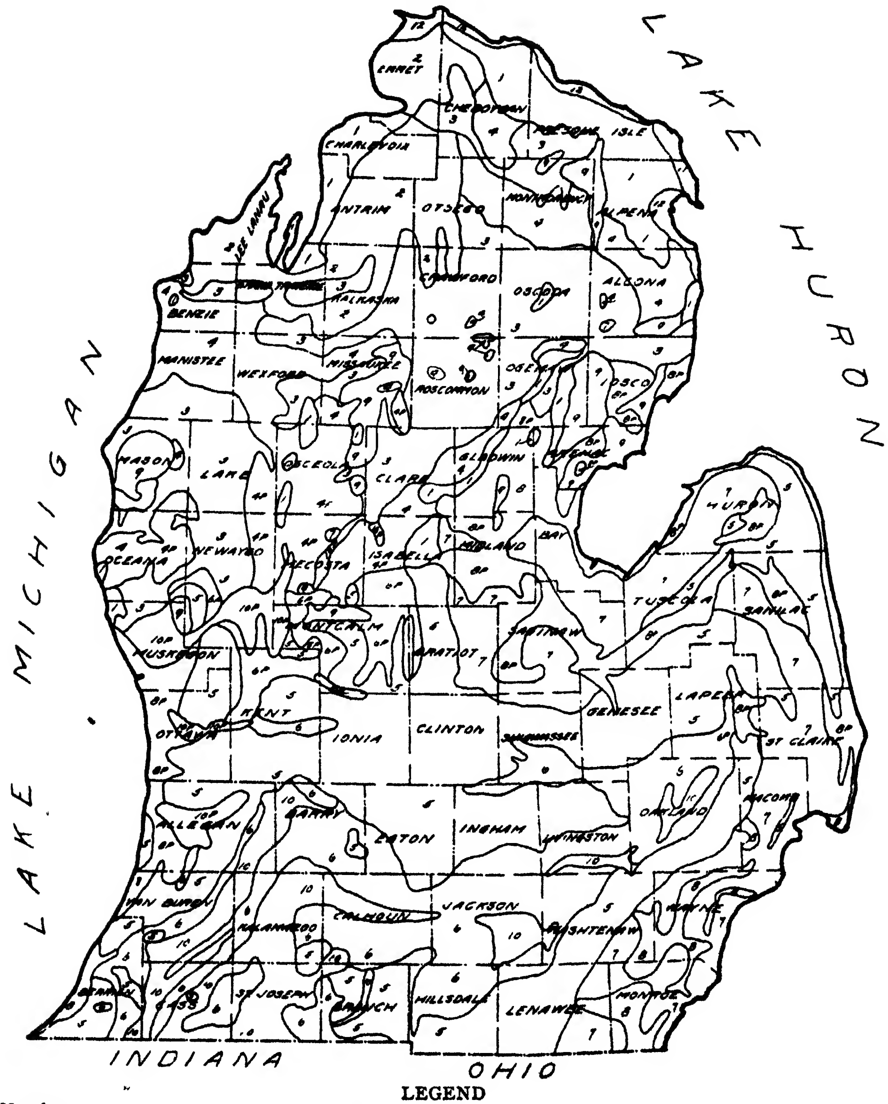


Reconstruction on the basis of soil type of the original forest cover of Aurelius and a part of Onondaga townships, Ingham County, Michigan. (Compare with soil map Fig. 1).

By J. O. VEATCH.

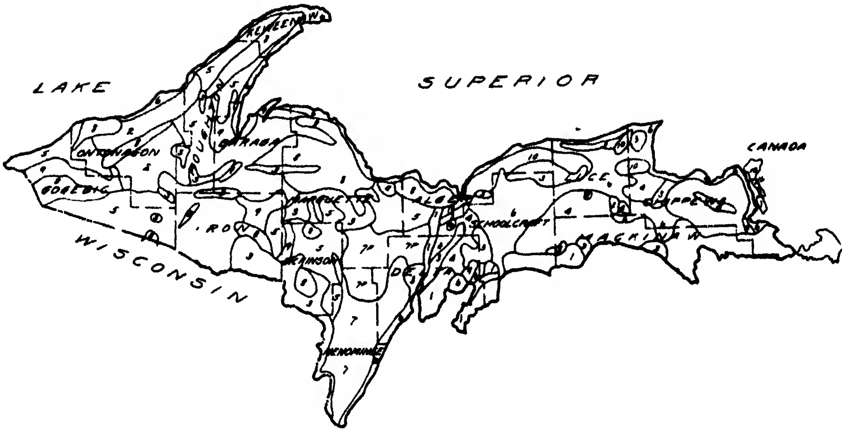
LEGEND

Association or characteristic species.	Other common trees.
No 7—Sugar maple (Acer saccharum) beech.	White oak, red oak, ash, elm, basswood, hickory, black cherry.
No. 6—Oaks—hickory.	Beech, elm, hard maple, basswood, present but generally subordinate in numbers to oaks and hickory.
No. 5—Elm, silver maple (Acer saccharinum)) Shagbark hickory, ash, swamp ,white oak, basswood.	Red oak, white oak, beech, sycamore, walnut.
No. 4—Elm, soft maple, ash.	Aspen, willow, basswood, tamarack.
No. 3—Tamarack. aspen, red maple. Shrubs—High-bush huckleberry, winterberry, redosier dogwood.	Willow, white birch, elm.
No. 2—Shrubs—Huckleberries, leather leaf, etc. Sphagnum moss, sedges and grasses.	Tamarack, willow, aspen, birch, may be present, but trees are dwarfed in size.
No 1—Silver maple, elm, ash, hickories, basswood, sycamore, walnut.	Notable for diversity of species. Aspen, black cherry, dogwood, tulip, beech, ironwoods, oaks, willow.



LEGEND

Number on map	Type of original forest
1	**Hardwood.** Sugar maple, beech, basswood, ash, elm, yellow birch.
2	**Hardwood.** Sugar maple, yellow birch, beech, elm, hemlock, white pine.
3	**Pine.** Norway, white, jack pines. Oaks.
4	**Hardwood-Conifer.** Sugar maple, beech, yellow birch, hemlock. Norway and white pine, local bodies or in mixture with hardwoods.
5	**Hardwood.** Sugar maple-beech (oaks, hickory and other southern species).
6	**Hardwood.** Oaks-hickory. 6 P, white pine abundant.
7	**Hardwood.** Elm, silver maple, ash, basswood, swamp white oak.
8	**Hardwood.** Oaks and oak-hickory, beech, maple on drier soils. Elm, silver maple, ash, basswood, pin oak, aspen, on wetter soils.
8P	**Hardwood-Conifer.** Similar to 8 but white pine and other conifers more abundant.
9	**Hardwood-Conifer.** Elm, ash, basswood, red maple; locally sugar maple-beech. Conifers, white pine, hemlock, balsam fir, spruce.
10	**Hardwood.** Oaks dominant. Oak-hickory. Sugar maple-beech type locally.
10P	White pine abundant or locally dominant.
11	**Conifer.** Cedar, spruce, balsam fir, white pine, Norway pine. In part 1 and 2 forest.
12	**Conifer. Hardwood complex.** Spruce-tamarack swamps, balsam fir, cedar, white pine, Norway pine, jack pine. Small bodies of 1, 2, 9 and 3.



LEGEND

Number on map	Type of Forest
1	**Conifer-Hardwood.** Cedar, spruce, fir, white pine dominant In part sugar maple, birch, beech forest
2	**Hardwood-Conifer.** Elm, ash, basswood, balsam fir, spruce, white pine
3	**Pine.** Norway, white and jack pines Oaks.
4	**Hardwood.** Sugar maple, yellow birch, elm, hemlock, beech
5	**Hardwood.** Sugar maple, yellow birch, elm, basswood, hemlock, balsam fir, (Beech rare or absent).
6	**Conifer.** Cedar, spruce, fir, tamarack swamps Pines on dry soils.
7	**Hardwood.** Sugar maple, yellow birch, ash, basswood, elm, beech
7P	White pine abundant. Also cedar, spruce, tamarack, fir swamps.
8	**Hardwood-Conifer.** No. 5 hardwood, and mixed white pine, Norway, aspen, oaks Conifer swamps.
9	**Hardwood-Conifer.** Balsam fir, spruce, hemlock, white pine, maple, yellow birch, basswood mixture, Spruce, cedar, fir, tamarack
10	**Hardwood.** Sugar maple, yellow birch, beech, hemlock

For several years, the writer has been collecting notes in connection with field work in soil mapping and soil classification in Michigan and has reached the conclusion that fairly close correlations do exist between the distribution of associations, as well as the character of growth of species, and soil types; and that these correlations can be established where the vegetational unit and the soil unit are of the same rank. From this basis, the idea has been further developed that a correlation, when carefully established, can be employed to reconstruct the original forest or plant cover, which has been to a large extent destroyed by lumbering and agricultural operations and of which no record is extant in the form of detailed maps.

Maps Will Have Practical Value

Reconstructed maps, if they can be made with some degree of scientific accuracy, will have a considerable historical value and a bearing upon practical and scientific problems for the forester and silviculturist, the ecologist and botanist, the soil scientist and the geographer. The map based upon the distribution of soils, even if not considered entirely sufficient within itself, can at least have a supplementary and confirmatory value in connection with other means of reconstruction.

In the reconstruction for any particular geographic unit a soil map

Soil-Forest Relationships, Southern Peninsula. (Refer to Map Fig. 3)

No. on map	Soils: Principal types	Soils: Character	Forest: Well drained soils	Forest: Poorly drained soils
1. .	Onaway, Posen, Ontonagon, Nester. Wet soils: Bergland, Selkirk, Ogemaw, Lupton muck.	Loams and sandy loams underlain by clay, fair humus; average moisture, medium to high; high content of lime in clay; fertility relatively high. Wet soils: Fertility relatively high; not highly acid.	Hardwood type dominant Sugar maple, beech, elm, ash, basswood, ironwood, birch	Elm, ash, red maple, aspen, white cedar, white pine, hemlock, balsam fir, Balm of Gilead. Mucks and peats—white cedar, spruce, balsam fir, white pine.
2. .	Emmet, Kalkaska, Mancelona, Coventry. Wet soils: Peat and muck, Newton, Saugatuck, Antrim, Bergland.	Sands and sandy loams underlain by sand, gravel and friable, penetrable sandy loams, humus, low to fair; average moisture, medium to low; acid surface, abundance of lime within reach of roots, fertility medium.	Hardwood type dominant. Sugar maple, beech, elm, yellow birch; hemlock and white pine locally abundant as constituents of the hardwood forest.	Muck and peat black spruce, tamarack, cedar, Newton and Saugatuck, white pine, aspen, spruce, fir, hemlock, Bergland; black ash, elm, red maple, cedar, fir, white pine, basswood.
3. .	Grayling, Rubicon, Roselawn, Ottawa, Coloma (transitional) Plainfield. Wet soils: peat and muck, Newton, Saugatuck.	Sands or light sandy loams to depths of 3 to 5 feet or more. Humus layer very thin, moisture low, soils acid to 3 feet or more, fertility relatively low. Wet soils; mostly acid; high percentage of highly acid peats	Pines dominant Norway white and jack; oaks scarlet, red and white, aspen, red maple	Wet mineral soils. White pine, Norway, aspen, spruce, balsam fir, tamarack. Peat and muck black spruce bogs, tamarack, spruce, cedar
4 .	Roselawn, Isabella, Nester, Ottawa, Wet soils associated: Peat and muck, Newton, Saugatuck, Ogemaw, Bergland type.	Sandy loams underlain at 1 to 4 feet by sandy and gravelly clay mixtures, friable to compact; fertility medium; moisture medium to low in the sandier parts of the profile; medium to high in the clayey part; medium to strongly acid in the sandy part; moderate lime content in the clayey part of the profile	Hardwoods and mixed conifer—hardwoods. Sugar maple, yellow birch, beech, hemlock, white pine and Norway pine locally abundant and in places dominant.	Black spruce, tamarack, white cedar, common on the peats; white pine, hemlock, fir additional on muck. Mixed white pine, hemlock, elm, red maple, ash and aspen on the mineral soils.
5	Miami, Conover, Isabella, Napanee, Hillsdale and Branch types. Wet soils associated: Brookston, Gilford, Brady, Granby; Carlisle muck, Rifle peat.	Loams, silt loams and clay loams in the surface horizons; compact and plastic to moderately friable clays in the subsurface horizons Medium to high fertility, moisture medium to high; moderate to high content of lime within reach of plant roots. Wet mineral soils, fertility relatively high	Hardwood Sugar maple, beech, elm, ash, basswood, hickories, oaks Walnut was present in notable amounts in the more southern areas	Tamarack characteristic on the peats. Elm, silver maple, ash, on the mucks Elm, ash, silver maple, basswood, swamp white oak, shag bark hickory, sycamore on the wet mineral soils.

Soil-Forest Relationships, Southern Peninsula.—Continued

No. on map	Soils: Principal types	Soils: Character	Forest: Well drained soils	Forest: Poorly drained soils
6...	Bellefontaine, Fox, Hillsdale, Coloma, Isabella, Ottawa types. Wet soils associated: Newton, Granby, Brady, Gilford, Saugatuck, Allendale, Berrien types; peats and mucks.	Sandy loams and sands in the surface horizons; subsurface or parent drift containing clay, but friable, pervious and penetrable; moisture medium to low; fertility medium to-low; surface commonly acid, but moderate lime content within reach of tree roots. Wet mineral soils: fertility medium to high.	Hardwood Oaks—hickory characteristic or dominant. Sugar maple, beech, elm, locally abundant. Areas marked 6 P, white pine present. and possibly dominant in places; occasional hemlock.	Tamarack characteristic of the peats; elm, silver maple, ash on mucks. Other species on peats and muck: aspen, willow. Peats and mucks constitute probably 10 per cent or more of the total area. Forest on wet mineral soils, same as in group 5.
7...	Brookston, Conover, Macomb, Napanee, Gilford, Clyde types. Small bodies of well drained sandy and gravelly soils, Plainfield, Fox and Ottawa types; also small bodies of Miami.	Loams, silt loams, clay loams, in the surface horizons; clay in the subsurface; fair to high content of humus and relatively high lime; soils generally not stony; root penetration limited in depth by density of clay, or high water table, or excessive water.	Maple—beech association and oaks or oaks-hickory minor.	Hardwood. Elm, silver maple, ash, basswood, hickory, swamp white oak, white oak, are characteristic species. Sugar maple and beech are present in places but are less abundant than in 5. Sycamore and walnut appeared in the more southern areas.
8...	Complex of Berrien, Plainfield, Ottawa, Fox, Newton, Granby, Gilford, Saugatuck, Allendale, Maumee, Bridgman, Ogemaw types. Mucks and peats less than 5 per cent of the total area.	Sands and sandy loams, dry, wet and semi-wet, with a wide range in organic matter, reaction and fertility. Fertility generally lower than in group 7.	Oaks dominant on the drier sandy soils such as the Plainfield, Fox, Bridgman, Ottawa. Mixture on the Berrien, Allendale and Gilford, including oaks, elm, beech, hickory, basswood and in the more southern areas cottonwood, sycamore, walnut tulip. White pine locally abundant in the more northern areas, 8 P.	Elm, ash, silver maple, red maple, aspen, pin oak, white oak, white cedar and white pine locally abundant in the more northern areas. 8 P.
9....	Selkirk, Bergland, Ogemaw, Allendale types.	Sandy soils with clay at shallow depths and locally clay at the surface; high to excessive moisture; moderate to high organic matter; medium to high fertility.	Sugar maple, beech, birch, basswood, hemlock, white pine on the clay soils.	Hardwood—Conifer complex. Elm, ash, soft maple, basswood, aspen in association with white pine, hemlock, arbor-vitae. Fir and spruce appear abundantly on the more northern areas.
10...	Fox, Plainfield types. Wet soils: mainly peats and mucks; small bodies of Newton, Granby, Saugatuck, Brady, Maumee.	Sandy loams and sands; medium to low in moisture in soil; relatively low in moisture in subtratum; humus low; fertility medium to low; acid surface; lime in form of limestone sand and gravel at 3 to 5 feet.	Oaks and oak-hickory. Red oak, white oak, black oak, bur oak, pignut, bitternut hickories; "oak openings." Locally beech and sugar maple; walnut appeared in places in more southern areas. Small prairies (Warsaw type of soil) in S. W. Michigan. 10 P, white pine locally abundant or dominant.	Tamarack characteristic of peats; elm, ash, silver maple, on mucks. Organic soil probably 10 per cent of total area. Elms, ash, basswood, silver maple, red maple, aspen, swamp, white oak, pin oak on the wet mineral soils.

Soil-Forest Relationships, Southern Peninsula.—Concluded

11...	Summerville, Alpena, and Posen types, together with bodies of Eastport and Rubicon sands. Mucks and peats; Granby, Detour and Ogemaw.	Mainly loams, gravelly and stony. Limestone bed rock or large masses of stone at shallow depths; humus fair; fertility high; moisture medium to low; strong limestone influence; depth of root penetration limited. Dry sands in part exhibit limestone influence; in part acid.	White pine, Norway pine, Arbor vitae; sugar maple, beech, elm, ash, basswood, on the thicker soil.	Arbor vitae, spruce, fir, white pine, dominant. Aspen, white birch, elm, ash, red maple, Balm of Gilead. Wet soils constitute 40 to 50 per cent of the total area.
12...	Eastport, Rubicon, Grayling, Alpena, Granby, Summerville, Ogemaw, Selkirk, Bergland, Posen types. Also a large per cent of muck and peat.	Complex of dry and wet sands; gravel, boulders, beach deposits; rock outcrop, dunes, peat and muck.	Norway, white and jack pines mixed with oaks, aspen, white birch.	Cedar, fir, spruce, white pine mixed with aspen, white birch, alder, elm, ash, Balm of Gilead, red maple on the mineral soils. Cedar, spruce, tamarack, on the peats and mucks.

Soil-Forest Relationships, Northern Peninsula. (Refer to Map Fig. 4)

No. on map	Soils: Principal types	Soils: Character	Forest: Well drained soils	Forest: Poorly drained soils
1	Johnswood, Alpena, Posen. Summerville, Longrie, Onaway, Eastport, Emmet, Detour. Wet soils, Detour, Granby, Trout Lake, Bergland, Ogemaw; mucks and peats.	Loams, sandy loams and sands, mainly gravelly, cobbly or stony or resting upon bed rock at shallow depths coarse fragmental matter mainly or high percentage limestone, fertility medium to high, except some of the sands, average moisture medium but in part low due to coarse nature, or small thickness of soil	Hardwood—Conifer Sugar maple, birch, beech, hemlock, white pine, spruce, fir, Norway pine, white pine cedar on the drier stony and sandy soils	Spruce, cedar, fir, hemlock, white pine, aspen, white birch alder, Balm of Gilead, elm, ash, red maple Wet soils constitute 20 to 30 per cent of the total area.
2	Ontonagon, Bohemian, Iron River types Wet soils: Bergland, Chippewa, Bruce types.	Clays, silts, very fine and fine sands. Average moisture relatively high; lime content medium to high at shallow depths; fertility relatively high, heavier clays difficultly penetrable Wet soils: relatively high fertility.	Hardwood—Conifer. Elm, ash, basswood, aspen, hemlock, white spruce, fir, white pine Locally white pine and hemlock were very abundant or even dominant Locally sugar maple—birch hardwood forest especially on Iron River loam and silt loam	Conifers dominant: hemlock, white pine, spruce, balsam fir, cedar. Associated deciduous species, aspen, elm, black ash, basswood, red maple, Balm of Gilead. Wet soils constitute 30 to 40 per cent of the area in Chippewa County
3 ..	Rubicon, Grayling, Stambaugh, Roselawn, Randville types. Wet soils: Peats: Newton and Saugatuck types.	Mainly sands and light sandy loams to depths of 3 to 5 feet or more; generally strongly acid to 3 to 5 feet, humus low, moisture low; fertility low to medium, soils in part cobbly and stony. Wet soils, acid, low fertility, organic soils mainly acid peats	Pines dominant Norway white and jack pines Oaks were relatively more abundant than elsewhere. On the more loamy soils sugar maple, birch, elm, mixed with conifers.	Black spruce, tamarack on the peats; spruce, cedar, balsam fir, aspen, white pine, on the mineral soils. Wet soils 5 to 10 per cent of total area
4 .	Emmet, Kalkaska, Longrie, Onaway, Roselawn types. Wet soils: mainly peats and mucks; Granby, Trout Lake, Newton and Saugatuck.	Texture of profile mainly sands and sandy loams; slight to strong limestone influence, moisture medium, fertility medium, for the most part penetrable and not excessively stony Wet soils, mostly sandy and medium in fertility; organic soils mainly peats	Hardwood. Sugar maple, yellow birch, beech, hemlock association	On peats and mucks: Black spruce, cedar, tamarack. Mineral soils, spruce, fir, cedar, white pine mixed with aspen, elm, black ash, red maple, yellow birch. Wet soils 10 to 15 per cent of total area.
5 ..	Iron River, Porcupine, Roselawn, Baraga types. Wet soils: Channing, Bergland, Saugatuck, undifferentiated stony soils resting on bed rock at shallow depths; peats and mucks.	Mainly loams and sandy loams underlain by clayey moderately to highly retentive horizons; soils in large part stony, mold covering relatively thick; acid to 3 to 5 feet, slight to no limestone influence; fertility medium to high; except most stony, penetrable to 3 to 5 feet or more	Hardwood Sugar maple, yellow birch, elm, basswood, with variable mixture of hemlock, balsam fir, white spruce, white pine. Beach is practically absent.	Conifer. White pine, hemlock, balsam, fir, cedar, spruce, mixed with elm, ash, aspen, Balm of Gilead. Spruce, cedar, tamarack, on peats and mucks. Wet soils 15 to 20 per cent of total area.

Soil-Forest Relationships, Northern Peninsula.—Concluded

6	Newton, Saugatuck, Eastport, Bruce, Shelldrake, Wallace, Granby, Alpena, Rubicon, Ogemaw types. Peats and mucks.	Complex of wet and dry sands, peats, mucks, clayey ferruginous stony and gravelly soils Great variation in texture and fertility, but mostly two extremes of moisture represented Wet soils constitute 50 to 60 per cent of the total area	Conifer Norway, white and jack pines, aspen, white birch Local patches of sugar maple—yellow birch association Oak in places	Conifer Spruce, tamarack, cedar on the peats and mucks. Spruce, balsam fir, cedar, hemlock, white pine, in mixture with elm, ash, red maple, basswood, white birch, on on the mineral soils
7	Onaway and Emmet types. Wet soils: Bergland, Ogemaw; peats and mucks Wet soils and peats and mucks constitute 20 to 30 per cent in 7 and 50 to 60 per cent in 7P.	Mainly loams and sandy loams, underlain by highly to moderately retentive clayey horizons, mold and humus relatively thick average moisture relatively high Content of lime high; fertility medium to high Wet mineral soils medium to high fertility	Hardwood Sugar maple, birch, elm, beech, basswood, ash In 7 P white pine abundant and locally dominant	Cedar, spruce, fir, tamarack on the peats. In addition hemlock, white pine, aspen, ash, elm, red maple in mucks White pine, balsam fir, hemlock, aspen, ash, elm, red maple. Balm of Gilead on mineral soils
8	Crystal Falls, Stambaugh, Baraga, Porcupine, Iron River and Roselawn types. Wet soils: mainly peat and muck, also Bergland, Channing, Gaastra, Ogemaw and undifferentiated stony soils	Large percentage of rock outcrop and excessively stony soils, mostly loams and sandy loams underlain by coarse drift, acid or very slight to no influence from limestone, relatively thick covering of mold; wide range in moisture, but mostly medium, fertility medium to high Wet soils, loams and sandy loams, relatively high fertility, both acid and alkaline	Hardwood—Conifer Sugar maple, yellow birch, elm, basswood, with a somewhat smaller proportion of hemlock, balsam fir and white pine On the thinner and drier stony soils and rock knobs, white pine, Norway, aspen, cedar, oaks with sugar maple, elm and yellow birch	Conifer Spruce, cedar, tamarack on the peats. Hemlock, white pine, elm, ash, aspen in addition on mucks Fir, hemlock, white pine, spruce with some aspen, elm, ash, red maple, basswood on the mineral soils. Wet soils constitute 15 to 20 per cent of the total area
9	Wet soils: Channing, Gaastra, Ogemaw, Bergland, Newton, Saugatuck, peats and mucks. These comprise 50 to 60 per cent of the total area Well drained soils: Iron River, Porcupine, Crystal Falls, Baraga, Ontonagon types.	Wet soils mainly sands and fine sandy loams, medium to high in fertility, generally acid, but in part alkaline Undifferentiated excessively stony loams and sandy loams on bed rock or impervious clay Well drained soils as in 5 and 8	Hardwood—Conifer Sugar maple, yellow birch, basswood, elm, hemlock, balsam fir, white pine association	Conifer Balsam fir, hemlock, spruce, white pine, cedar with some mixture of elm, ash, aspen, basswood, yellow birch. Cedar, spruce and tamarack on the peat and muck soils.
10	Munising and Roselawn types Wet soils mainly peats; Newton and Saugatuck types.	Mainly light sandy loams and sands, penetrable and friable; mold covering medium; moisture medium, fertility medium. Acid to depths of 3 to 5 feet or more, very slight to no limestone influence	Hardwood. Sugar maple, yellow birch, beech. hemlock association White pine locally abundant.	Conifer. Spruce, cedar, tamarack on the peats. Balsam fir, white pine, aspen, ash, elm, red maple, on the wet mineral soils Wet soils constitute 15 to 20 per cent of the total area

is of course prerequisite and some remnants of the original plant cover must be available.

The accuracy of the map is dependent upon the soundness of the correlation of the plant association with the unit of soil mapping, so that experience and judgment on the part of the observer is presupposed. Relationships established are frequently found to be restricted to rather narrow geographic limits. The upsetting conditions such as fires, landslides, tornadoes, recent changes in water level, and plant disease infestation are probably local in their effects but, of course, are factors to be considered by the observer.

As an illustration of the idea here advanced, two forest maps, and corresponding soil maps, are presented; one detailed for a small selected area in Ingham County, Michigan, and one showing the general relationships of the forest cover to the broader soil groups of the State. The map of the State is necessarily generalized and tentative; it is subject to correction as further knowledge of the detailed distribution of soils is obtained and as the relationships with cover are placed upon some kind of a quantitative basis. Fig. 3 shows the reconstruction of the forest cover, on the basis of the distribution of soil groups, Southern Peninsula of Michigan. Fig. 4 shows the reconstruction of the forest cover, on the basis of the distribution of soil groups, Northern Peninsula of Michigan. In addition to the legends on the maps the relationships between soil and forest cover are amplified in the following tables.

ADOPT NEW POLICY OF LEGUME CULTURE DISTRIBUTION

College Lacks Facilities to Meet Increased Demand for Cultures

BY WARD GILTNER, BACTERIOLOGICAL SECTION

For nearly twenty years the bacteriological laboratory of the Michigan State College Experiment Station has prepared cultures of the nodule-forming or nitrogen-fixing bacteria for the inoculation of the legumes. Several hundred thousand of these cultures have been sent out to Michigan farmers directly and indirectly through the very helpful co-operation of county agricultural agents and the farmer co-operative associations. This work has grown to such proportions, and, simultaneously, other lines of work have developed so tremendously that facilities are no longer available at the college to adequately meet the demands for the cultures.

It has been demonstrated that under favorable conditions the cultures are an aid to economical soil nitrogen supply. When all the teachings of soil science, relating to soil physics and chemistry, and of farm crops, relating to seed selection and plant culture, have been

applied to the cultivation of a legume, then, and only then, are the nitrogen-fixing bacteria helpful. The bacteriological laboratory recommends the use of the cultures in most cases but only where proper preparation has been made for the cultivation of the legume.

Increased Demand Compels Change

Due to the increased demand for the cultures and to the numerous other demands on the facilities of the laboratory, it has been necessary to make a new arrangement for the preparation and distribution of the cultures of nitrogen-fixing bacteria. Professor S. F. Edwards, a graduate of Michigan State College, has consented to take over this work without salary. Professor Edwards was a pioneer in the development of the cultures on a practicable or commercial scale while he was in charge of the Department of Bacteriology at the Ontario Agricultural College at Guelph. He has been added to the staff of the bacteriological laboratory and has been placed in charge of the legume culture preparation and distribution.

We consider it very fortunate that this arrangement will permit Dr. R. M. Snyder to again devote practically his entire time to investigational work in the important field of soil and plant bacteriology. Already he has under way and nearing completion some interesting studies on the decomposition of peat. During the past few years, while the burden of the culture work has increased yearly to its present overwhelming magnitude, Dr. Snyder has been in full charge and to him is due all the credit for the marked success of the undertaking.

It has been necessary to increase the price of the cultures to fifty cents for one bottle (enough to inoculate one bushel of seed). An arrangement has been made whereby county agricultural agents and farmer co-operatives may get the cultures at a special rate.

Hereafter all requests for cultures should be addressed to:

S. F. EDWARDS,
729 West Ionia St.,
Lansing, Mich.
Phone 2-9443

TWO SPRUCE CHERMES INFEST MICHIGAN SPRUCE

Ornamental Conifers Damaged by Two Species of Plant-Lice

EUGENIA I. MC DANIELS, ENTOMOLOGICAL SECTION

Two plant-lice whose work mars the beauty of ornamental conifers are attracting attention in Michigan. One of these, the Spruce Gall Aphid, *Chermes abietis*, is an old offender and apparently has been with us since early times; while the other species, *Chermes similis*, which

Fig. 1.—*Chermes abietis*. Eggs laid by overwintering aphids on spruce, early in spring.

may have been with us for a more or less extended period, has only recently been identified and its presence noted. Both these plant-lice produce galls which resemble cone-like growths at the tips of the twigs, both apparently confine their depredations to Norway, black, white, and red spruce of which the Norway seems to suffer the most injury, and both species pass the winter in an immature stage tucked away in crevices about the bud scales.

The spruce gall aphid, *Chermes abietis,* sometimes known as the pine-apple gall-aphid, causes the formation of compact galls at the bases of new growth. The gall remains green until the aphids within are ready to emerge. The emergence usually takes place about the middle of August. The galls then turn brown, though the terminal growth may remain green for some time. The old, dead galls usually remain on the trees several seasons and, with the gradual death of the branch, render the tree unsightly.

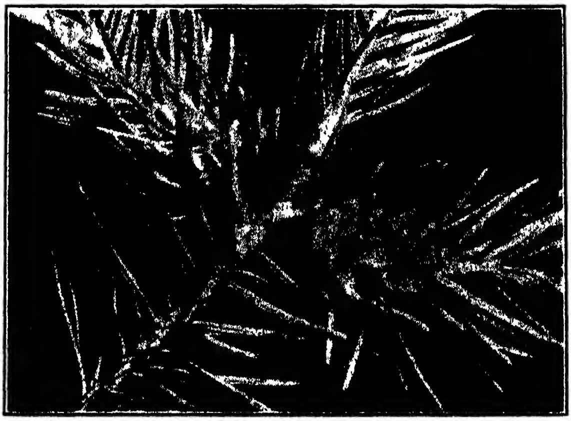


Fig. 2.—*Chermes abietis,* spruce cone galls in mid-summer.

Chermes similis, builds a loose terminal gall at the very tip of the new growth. This gall ripens about two weeks earlier than that of *abietis* and the terminal growth turns brown and dies shortly after the plant-lice emerge. Apparently, neither species has an alternate host, and neither species spreads rapidly though winged forms exist in both life cycles. They seem to prefer individual trees and from such trees the infestation spreads slowly.

Control. Hand picking of the galls before the plant-lice emerge will control many infestations on ornamental plantings. Wherever hand picking is impossible, one of the following sprays should be applied in the spring just before the new growth starts. Applications made later than this may cause injury to the trees and no spray can be effective after the aphids are enclosed within the galls.

Oils. Miscible oils diluted to about 1 to 20 or an oil emulsion used at two per cent strength, applied in the spring just before growth starts, has proved very satisfactory. When a miscible oil is applied, the strength recommended by the maker should be used, and care

should be taken to be certain that the ingredients of the container are thoroughly mixed. In either case be sure the emulsion is perfect before making the application. When oils are used, care must be taken to time the application so that the temperature will not fall below freezing until the spray has dried.

Oils are especially recommended where the spruce mite, *Paratetranychus ununguis,* is present, for, while certain other sprays will control the plant-lice if properly timed and applied, they have not been as effective for use against the mite as oils.

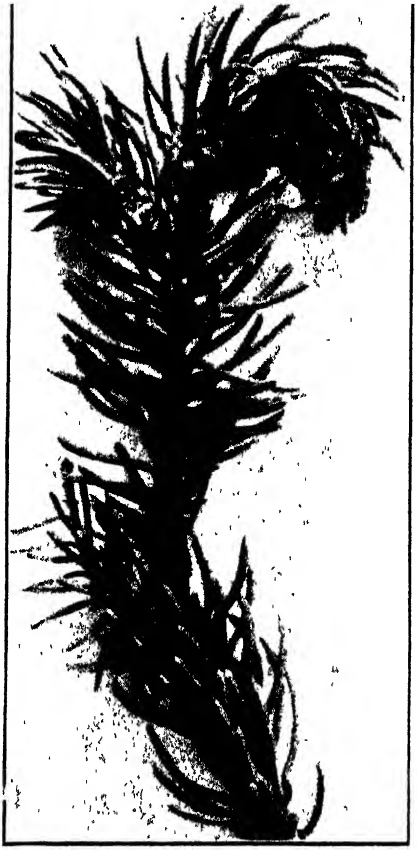


Fig. 3.—Work on *Chermes similis* collected in early winter.

Nicotine Sulphate. Good results have been obtained with the use of nicotine sulphate at the standard strength (1 pint of 40 per cent nicotine sulphate to 100 gallons of water plus four pounds of laundry soap). The application must be made just before the aphids have enclosed themselves in galls.

Cautions

The spraying of conifers is generally looked on as an uncertain proposition, but, if the tree is doomed unless some remedial measure is taken, one should not hesitate. The above sprays which have been discussed have been in use for several seasons and, to date, no serious results have followed their application.

Whatever spray is used, care must be taken to hit the tip ends of the limbs especially the undersides, since this is where the majortiy of the plant-lice seem to seek winter quarters.

After the application of any of the above sprays, the "bloom" will be removed from the tree and the foliage will be of an almost uniform green lacking the bluish cast which renders the white spruce so attractive.

• STUDY MADE OF ROOT DEVELOPMENT OF LEGUMES

Soil Types and Thickness of Stand Affect the Root Development of Crops

BY M. M. MC COOL, SOILS SECTION

Additional knowledge concerning factors which influence the root development of plants is desirable. The continuation of the practice of turning under crops or portions of them for the purpose of adding organic matter to the soil brings up questions concerning the amounts of organic material added by means of the root systems of the different crops utilized. What is the effect of soil type, thickness of stand, and age of plants on the nature of the development of these roots? Are they coarse or fine and is the rate of decay affected by these characteristics?

In order to obtain information on the effect of soil type and thickness of seeding, alfalfa, sweet clover, and red clover were seeded by G. R. Schlubatis, J. D. Romaine and F. W. Trull during May, 1926, on Brookston silt loam, Miami loam, Hillsdale sandy loam, Isabella sandy loam, and Coloma loamy sand. These five soil types are important from an agricultural standpoint in Michigan and, in some respects, they are strikingly different one from another. The seed was drilled in the row seven inches apart at the rate of 15 pounds per acre.

One portion of the area thus seeded was thinned so that the plants stood seven inches apart in the rows. The number of plants in the unthinned portion ranged from 10 to 12 per foot of drill. Late in October, 1926, 50 or more plants were removed from each of the experimental plots, care being exercised to obtain as nearly as practicable the entire root system. Records of the size and the character of the

root development were made and photographs were taken. In addition, plants were taken from the alfalfa plot one year later.

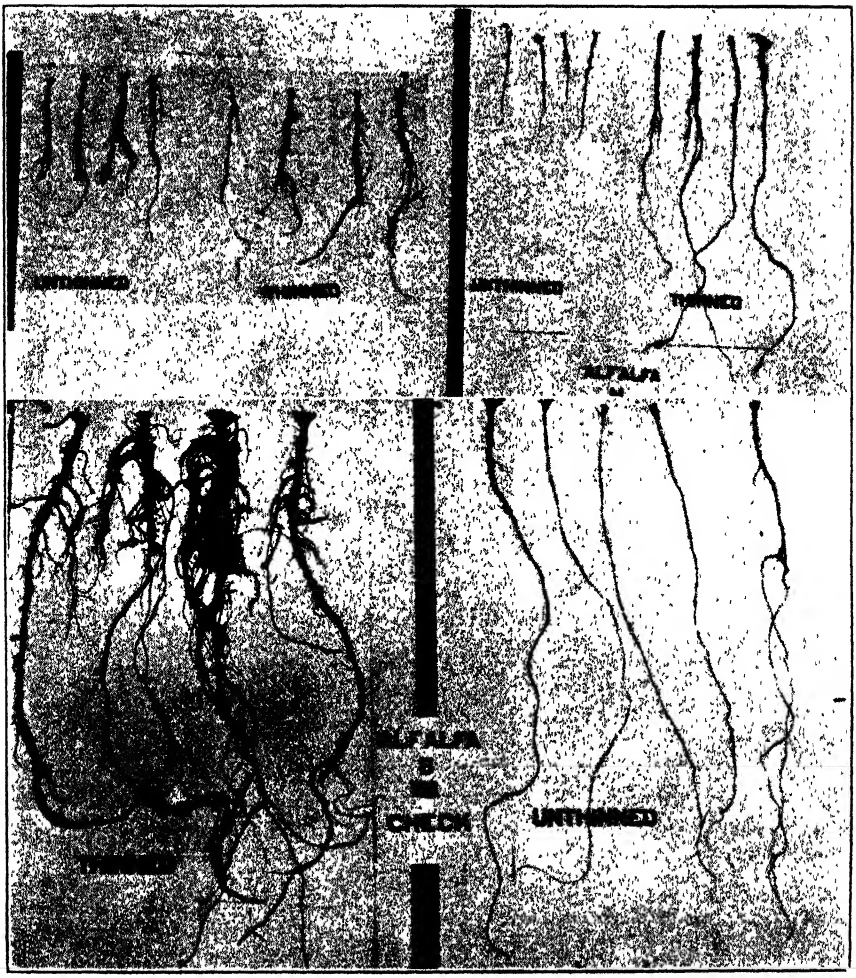
Results

The results obtained showed marked differences in the extent and nature of the root development of the plants when they were grown on different soil types. The observations made and the data in Table 1 show that there were striking differences between the root development of the plants which stood considerable distances apart in the row and those which were grown in close proximity to each other. The roots of the latter plants were smaller, carried fewer lateral branches, and usually did not penetrate as deeply into the soil as those of plants which stood farther apart in the rows.

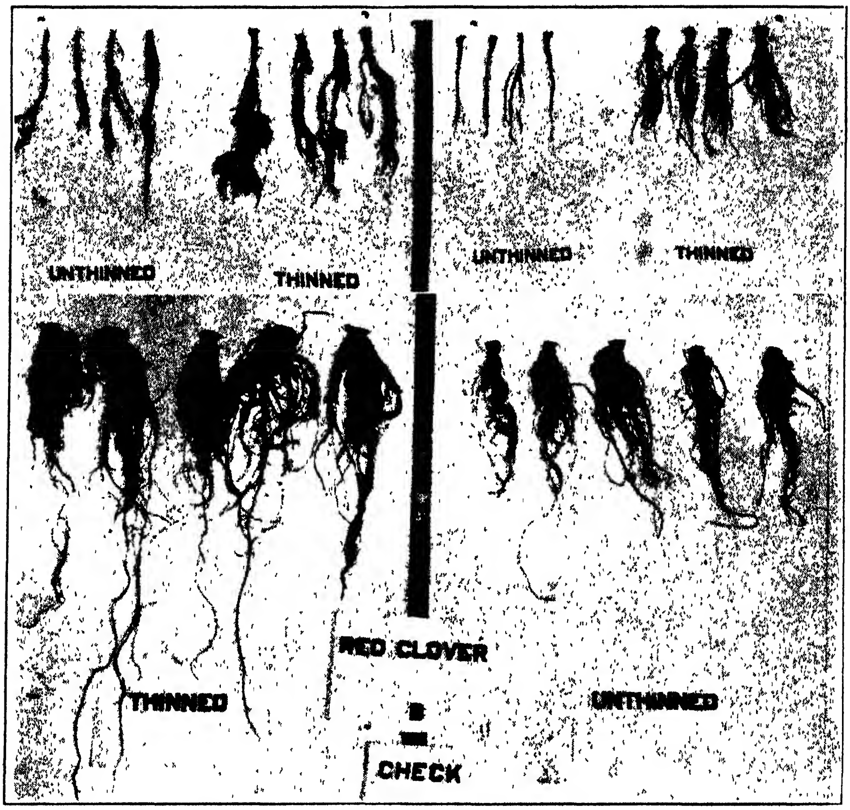
Such variations may account in part at least for the differences in the effectiveness of the same or different crops when used for green-manuring purposes. It is proposed to investigate further the factors which may influence the root development of these crops.

Table 1.—The Effect of Soil Type and Rate of Seeding on the Root Development of Alfalfa, Sweet Clover and Red Clover.

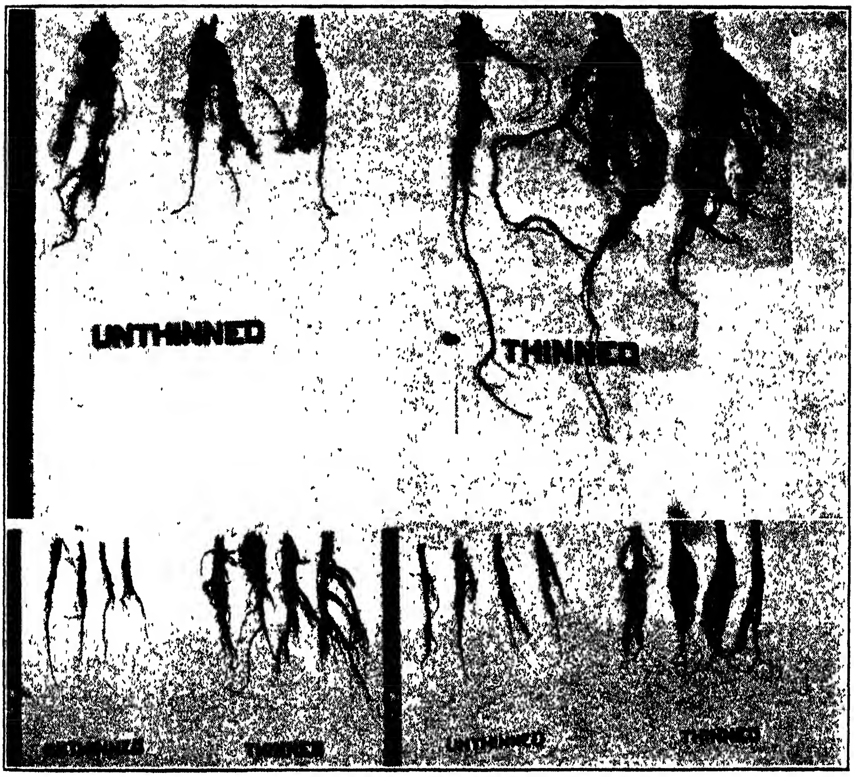
	Seeded May, 1926, and roots removed October, 1926					
	Brookston		Miami		Hillsdale	
	Av. weight gms.	Av. length in.	Av. Weight gms.	Av. length in.	Av. weight gms.	Av. length in.
Alfalfa:						
Thinned	5 4	42	3 8	26	2 91	22
Unthinned	2 7	40	1 17	8	1 04	9
Sweet Clover:						
Thinned	....	45 5	3 60	22	1 55	18
Unthinned	.. . ..	43 1	2 20	10	85	13
Red Clover:						
Thinned	3.3	14 9	1 9	10	.78	5
Unthinned	2 1	11 8	1 2	8	43	4
Roots removed October, 1927						
Alfalfa:						
Thinned	8 2	49	9 75	43	11 5	4.0
Unthinned	3 1	44	1 55	14	2 86	19



Figs. 1, 2, and 3.—Alfalfa roots showing effect of thinning; grown on Isabella sandy loam (Fig. 1), Miami loam (Fig. 2), and Brookston silt loam (Fig. 3).



Figs. 4, 5, and 6.—Red clover roots, thinned and unthinned, grown on Isabella sandy loam (Fig. 4), Miami loam (Fig. 5), and Brookston silt loan (Fig. 6).



Figs. 7, 8, and 9.—Sweet clover roots, thinned and unthinned, grown on Isabella sandy loam (Fig. 7), Miami loam (Fig. 8), and Hillsdale sandy loam (Fig. 9).

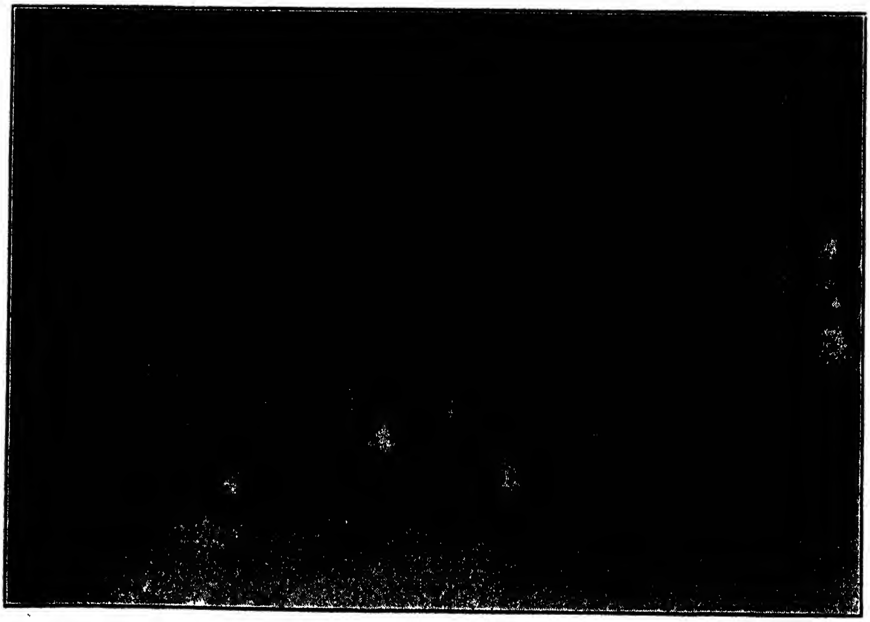
COMPARISON MADE OF PROTEIN SUPPLEMENTS FOR HOGS

Alfalfa, Tankage, and Linseed Meal Used in Experimental Feeding Trials to Determine Rate of Gains

BY W. E. J. EDWARDS AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

This experiment was conducted to study the comparative feeding value of (1) alfalfa meal and alfalfa hay, (2) alfalfa meal and linseed meal, (3) alfalfa meal and linseed meal compared with alfalfa hay and linseed meal, when each of the above combinations was fed with a basal ration of shelled corn, tankage, and minerals for growing and fattening fall pigs.

The experiment was started Jan. 21, 1927 and was terminated, for the respective lots, when the pigs averaged approximately 200 pounds in weight. The experiment was conducted in the College piggery, each group of pigs having a pen nine feet by 11 feet with access to an outside lot 11 feet by 14 feet.



Champion pen of Tamworth barrows exhibited by Michigan State College at International Livestock Show, Chicago, 1927. Barrow on right was champion individual.

Rations

Lots 1. Shelled corn, tankage three parts and alfalfa meal one part mixed, and minerals self-fed, free choice.

Lot 2. Shelled corn, tankage, alfalfa hay and minerals, self-fed free choice.

Lot 3. Shelled corn, tankage two parts and linseed meal one part mixed, and minerals self-fed, free choice.

Lot 4. Shelled corn, tankage two parts, lineseed meal one part and alfalfa meal one part mixed, and minerals, self-fed, free choice.

Lot 5. Shelled corn, tankage two parts and linseed meal one part mixed, alfalfa hay and minerals self-fed, free choice.

The mineral mixture used was composed of steamed bone meal 45 pounds, pulverized limestone 20 pounds, and common salt 30 pounds.

Each group of pigs had access to water in an automatic waterer.

The feeds used were shelled yellow corn, sixty per cent tankage, old

Table 1.—Results of Shelled Corn and Tankage, Linseed Meal and Alfalfa Supplements Experiments—1927.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	Sh. corn (tankage 3 pts., alf. meal 1 pt.), minerals self-fed, free choice	Sh. corn, tankage, minerals, alfalfa hay self-fed, free choice	Sh. corn, (tankage 3 pts., linseed meal 1 pt.), minerals self-fed, free choice	Sh. corn (tankage 2 pts., linseed meal 1 pt., alf. meal 1 pt.), minerals self-fed, free choice	Sh. corn (tankage 2 pts., linseed meal 1 pt.), alf. hay, minerals self-fed, free choice
Av. initial weight (lbs.)	57 50	55.62	56 87	58 62	56.75
Av. final weight (lbs.)	205 00	202.14	206.71	199.86	201.00
Av. daily gain per pig (lbs.)	1 135	1 251	1.136	1 054	1 219
Days to reach approx. 200 lbs	129.	111	129	131	119
Av. daily feed consumed (lbs.):					
Shelled corn	4 301	4 261	4.011	3 963	4 066
Supplement mixtures	.569	.566	.695	.700	.770
Alfalfa hay	....	.085	....	....	.101
Minerals	013	012	.010	.015	015
Total	4.883	4 924	4 716	4 678	4 952
Feed required for 100 lbs gain (lbs.):					
Shelled corn	378 77	340.60	353 24	375 88	333 71
Supplement mixtures	50.15	45 25	61 16	66 40	63.17
Alfalfa hay	....	6.783	....	....	8.319
Minerals	1.112	.969	.912	1.413	1.213
Total	430 03	393.60	415.31	443 69	406 41
*Feed cost for 100 lbs gain:					
Shelled corn	$5 68	$5 11	$5 30	$5 64	$5 01
Supplement mixtures	1 66	1 70	2 14	2 03	2 16
Alfalfa hay	....	06	....	....	07
Minerals	02	01	01	02	02
Total	7 36	6 88	7 45	7 69	7 26
Feed cost for 100 lbs. gain:					
Corn at $0.98 per bu	8 31	7 73	8 33	8 63	8 09
Corn at $1.12 per bu	9 26	8 58	9 21	9 57	8 92

Other feeds at prices as given below.

*Feed prices used: Corn $0.84 per bu., tankage $75.00 per ton, linseed meal $55.00 per ton, alfalfa meal $40.00 per ton, alfalfa hay (choice 2nd or 3rd cutting) $18.00 per ton, minerals $30.00 per ton.

Note.—Feeds inclosed in braces were mixed before being placed in self-feeder.

process linseed meal, western grown alfalfa meal, and locally grown second and third cutting good quality alfalfa hay.

Summary

1. Alfalfa hay produced somewhat more rapid gains and required considerably less feed for 100 pounds gain than did alfalfa meal or linseed meal when each was fed with shelled corn, tankage, and minerals as shown by Lots 1, 2, and 3.

2. Alfalfa meal made practically the same daily gains, but required somewhat more feed for 100 pounds gain than did linseed meal, when each was fed with shelled corn, tankage and minerals as shown by Lots 1 and 3.

3. The addition of linseed meal to a mixture of tankage and alfalfa meal produced somewhat less rapid gains and raised the feed requirements slightly when each mixture was fed with shelled corn, tankage and minerals as shown by Lots 1 and 4.

4. The addition of alfalfa hay to tankage and linseed meal when each combination was fed with shelled corn and minerals increased the gains somewhat and reduced the feed requirements for 100 pounds of gain as shown by Lots 3 and 5.

5. Alfalfa hay with tankage and linseed meal made appreciably larger daily gains and required considerably less feed for the gains produced than did alfalfa meal with tankage and linseed meal when each was fed with shelled corn and minerals as shown by Lots 4 and 5.

6. The addition of linseed meal to a ration of shelled corn, tankage, minerals and alfalfa hay produced slightly less rapid gains and required somewhat more feed for 100 pounds of gain as shown by Lots 2 and 5.

The results given above, covering but one experiment, should not be considered as being conclusive. The experiment is being repeated at this Station at the present time.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

251 Insects of 1907.
258 Insects of Field Crops.
262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
273 Utilization of Muck Lands.
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

58 Foul Brood.
65 Hog Cholera and Preventive Treatment.
71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
74 Analysis of Some Materials Sold as Insecticides and Fungicides.
76 Transferring Bees.
79 Michigan's Shifting Sands; Their Control and Better Utilization.
80 Yellow Rocket (a dangerous weed).
82 Durability of Concrete Drain Tile No. 11.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
99 The Detroit Commission Plan of City Milk Administration.
100 Soy Beans.
101 Oats in Michigan.
103 Forest Planting in Michigan.
104 Soils of Detroit Area.
105 Rosen Rye.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.

109 Dependable Michigan Crop Varieties.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
116 The Agriculture of the Upper Peninsula of Michigan.
118 Pruning Fruit Trees.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
122 Improvement of the Farm Woodlot.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.
132 Field and Garden Insects.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management of Commercial Apiaries.
136 The Muck Soils of Michigan.
137 Marketing Michigan Potatoes.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
148 Some Important Grape Insects.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs for Landscape Planting in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
***162 Pruning the Red Raspberry.**
163 Forest Planting in Michigan.

†164 Diagnosing Orchard Ills.
***165 Management Methods in the Raspberry Plantation.**
***166 Studies in Orchard Management with Special Reference to Cherry Production.**
***167 Chicory Growing in Michigan.**
***168 The Management of Michigan Muck Soils For Onion Production.**
174 Spraying Calendar.

Circular Bulletins—

28 The Bean Maggot in 1915.
34 More Wheat for Michigan.
37 Raspberry Culture.
41 State Laws Governing and Protecting the Planting of Street Trees.
43 Increasing the Production of the Bearing Apple Orchard.
44 The European Corn Borer.
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49 The Hessian Fly.
50 Hairy Vetch.
52 The Grape Berry Moth in 1922.
53 Standard Fertilizers for Michigan.
55 Lime Requirement for St. Joseph County.
56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the Eurpeon Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.

*Bulletins listed in bold faced type are recent publications of this Station.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it upon the receipt of ten cents (coin or stamps).

76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
86 Cherry Fruit Fly.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
89 Culture Greenhouse Lettuce.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
92 Garden Flowers.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
98 How to Make and Preserve Cider.
99 House Plants.
100 Michigan Farmers Tax Guide.
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Dunbar, Chippewa County, Forestry Station, 577 acres deeded.
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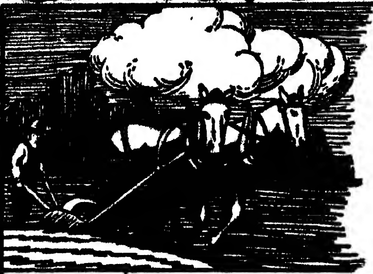

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CONTRIBUTIONS BY ALL SECTIONS OF THE
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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. 10, No. 4, May, 1928

DAIRY CATTLE NEED PHOSPHORUS IN RATION

Lack of This Element Causes Depraved Appetites of Animals

O. E. REED AND C. F. HUFFMAN, DAIRY SECTION

Depraved appetite, a craving for things not classed as food such as wood and bones, which occurs in cattle is usually due to a lack of phosphorus in the ration. It is prevalent in regions where the soil is deficient in phosphorus. This condition usually occurs among young cattle and milking cows where the rations consist of roughages, such as hay, silage, and pasture. Cattle may also suffer from a phosphorus deficiency when roughages are supplemented with cereal grains, such as corn and oats, which are low in phosphorus.

Depraved appetite can usually be relieved by feeding phosphorus either in the form of protein concentrate or as special steamed bone meal. Feeding a mixture of two parts of special steamed bone meal to one part salt will usually relieve the depraved appetite, although, occasionally, a cow will become a chronic wood or bone chewer and the addition of phosphorus has but little effect on the habit.

Most home grown feeds are low in phosphorus, which is the mineral element most likely to be deficient in the ration of dairy cattle. Phosphorus is needed for bone and muscle formation in the growing animal and for milk production and skeleton maintenance in the milking cow. Roughages, such as hay, silage, and grass are inherently very low in phosphorus as the following table shows:

	*Per Cent Phosphorus
Wheat Straw	.036
Beet Pulp (dry)	.062
Corn Stover	.095
Timothy Hay	.113
Clover Hay	.169
Alfalfa Hay	.221

In certain sections of Michigan, the roughages are even lower in phosphorus than normal, due to a phosphorus deficiency in the soil.

Ten samples of alfalfa secured in the vicinity of East Lansing, Michigan,

*Ohio Agricultural Experiment Station Bul. No. 255.

were low in phosphorus as the following analyses reported by the Department of Experiment Station Chemistry indicates:

Alfalfa Hay

Sample	Per Cent Calcium	Per Cent Phosphorus
No. 1	1.175	.161
No. 2	1.428	.167
No. 3	1.595	.187
No. 4	1.412	.177
No. 5	1.563	.190
No. 6	1.720	.201
No. 7	1.270	.186
No. 8	1.740	.140
No. 9	.....	.153
No. 10	1.580	.163
Average	1.498	.173
Average reported by Forbes[1]		.221
Average from regions affected with phosphorus deficiency as reported by Eckles[2]		.189

It is of interest to note that only two of the ten samples of Michigan alfalfa hay are higher in phosphorus than the average figure reported by Eckles and his collaborators for alfalfa grown on farms where depraved appetite occurred in the Red River Valley of the North. This deficiency in phosphorus of Michigan alfalfa may be responsible for the occurrence of depraved appetite in certain sections of the State.

Protein Concentrates as a Source of Phosphorus

The common protein concentrates fed in Michigan are fairly high in phosphorus as the following table shows:

	Per Cent Phosphorus
Cottonseed Meal	1.352
Wheat Bran	1.110
Wheat Middlings	.876
Linseed Oil Meal	.705
Soy Beans	.592
Gluten Feed	.542

When a grain mixture containing either wheat bran, cottonseed meal, or linseed oil meal is fed liberally, there is little need for additional phosphorus in the form of a mineral supplement. Depraved appetite rarely occurs among cattle fed wheat bran, cottonseed meal, or linseed oil meal.

Raw Rock Phosphate as a Source of Phosphorus

Raw rock phosphate is a mineral deposit originating from the skeletons of sea animals and contains calcium and phosphorus in about the same

[1]Ohio Agricultural Experiment Station Bul. No. 255.
[2]Minnesota Agricultural Experiment Station Bul. No. 229.

proportion as bone meal. In the last few years, considerable high grade raw rock phosphate has been sold as a mineral supplement to supply lime and phosphorus. Several commercial mineral mixtures use raw rock phosphate under the name of bone phosphate of lime.

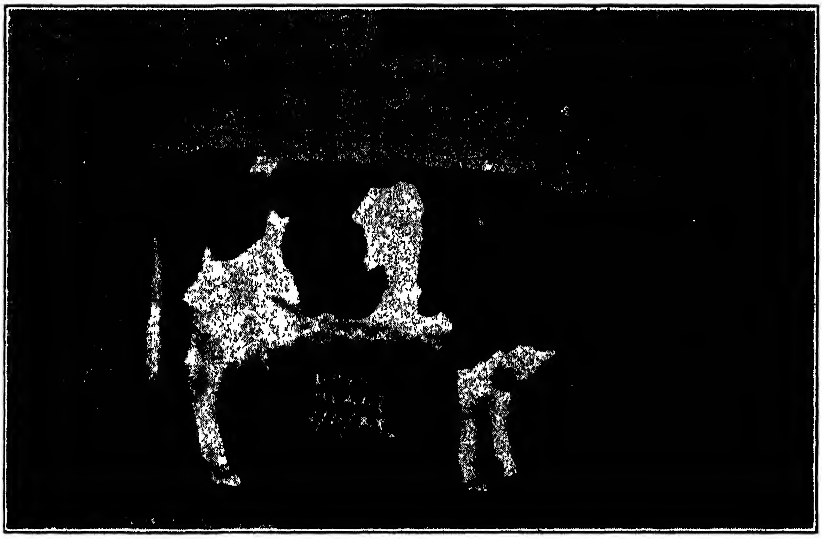


Fig. 1.—After four years of bone flour feeding.

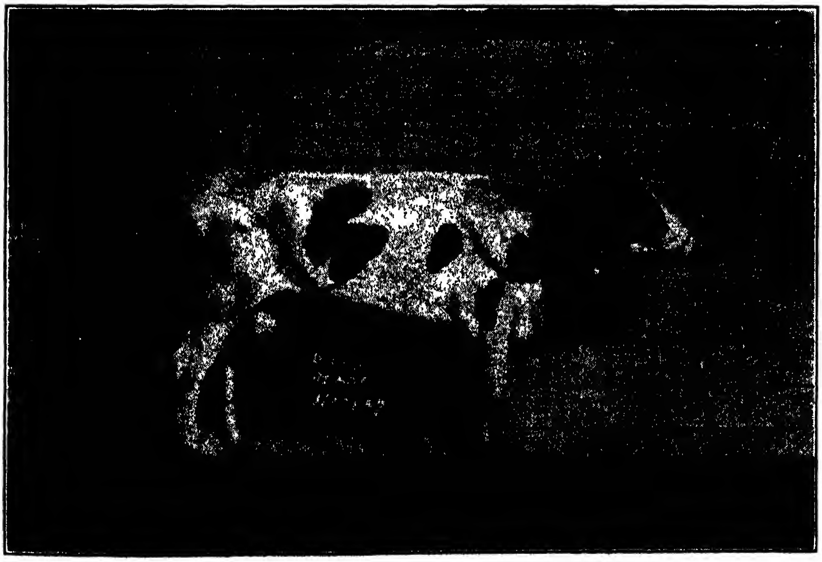


Fig. 2.—This animal received the same basic ration as the cow in Fig. 1, except a mixture of equal parts limestone rock and raw rock phosphate was fed in place of bone flour.

In 1922, the Dairy Department, Michigan State College, started a long time mineral feeding experiment to determine the value of different minerals in the ration of dairy cattle. One lot of heifers has received raw rock phosphate in their ration since they were a few days of age. The teeth of these animals became sensitive to cold water at about two and one-half years of age. Since that time, it has been necessary to warm the drinking water for these animals during the winter.

An examination of the mouths of these animals revealed the trouble. The raw rock phosphate had brought about a softening of the teeth and, in some instances, the teeth were actually worn down to the gums. The results of this long time experiment indicate that raw rock phosphate is harmful to dairy cattle when fed as one and one-half per cent of the grain mixture over a long period of time.

We have also determined the relative value of raw rock phosphate and steamed bone meal in short feeding tests.

Six mature cows were used in one test. These cows were fed 20 days on a basic ration consisting of grain mixture, silage, and timothy hay. Three of the animals were then fed three per cent of the grain ration as bone meal and three were fed three per cent of the grain ration as raw rock phosphate.

The three animals receiving raw rock phosphate went off feed the second day after the addition of this mineral. The three on bone meal had normal appetites. At the end of 20 days, the minerals were taken from both groups and the basic ration fed for 20 days. The cows on the raw rock phosphate ration became emaciated, but regained their health to some extent after being placed on the basic ration. When bone meal was fed to these three animals, no deleterious effects were noted. The other three cows that had received bone meal during the second period were normal throughout this period. However, during the third period when raw rock phosphate was added to the ration these animals also went off feed. The bad effect of raw rock phosphate was not due entirely to the effect on palatability of the grain ration. The consumption of hay and silage was also below that of the check and bone meal periods. Apparently, the raw rock phosphate brought about a digestive disturbance in these animals. In another test with a different sample of raw rock phosphate which is especially recommended for livestock feeding, similar results were obtained but the digestive disturbance was not marked as in the previous test.

Another group of four healthy milking cows were fed the ordinary herd ration to which three per cent of special steamed meal was added to the grain mixture. Chart 1 shows their consumption of grain and alfalfa hay for five days while on this ration. The three per cent bone meal was then replaced by three per cent high grade raw rock phosphate. There was an immediate drop in grain consumption for all four cows. The hay consumption was also somewhat reduced. This again shows that the effect on food consumption is not due entirely to the lack of palatability of the raw rock phosphate.

Apparently, there is some factor in raw rock phosphate which disturbs the digestive system. Dr. E. B. Forbes of Pennsylvania State College suggested the possibility that the bad effects of raw rock phosphate may be due to the high fluorine content. This phase of the problem is under investigation at the Michigan Station by the Dairy Department at the present time.

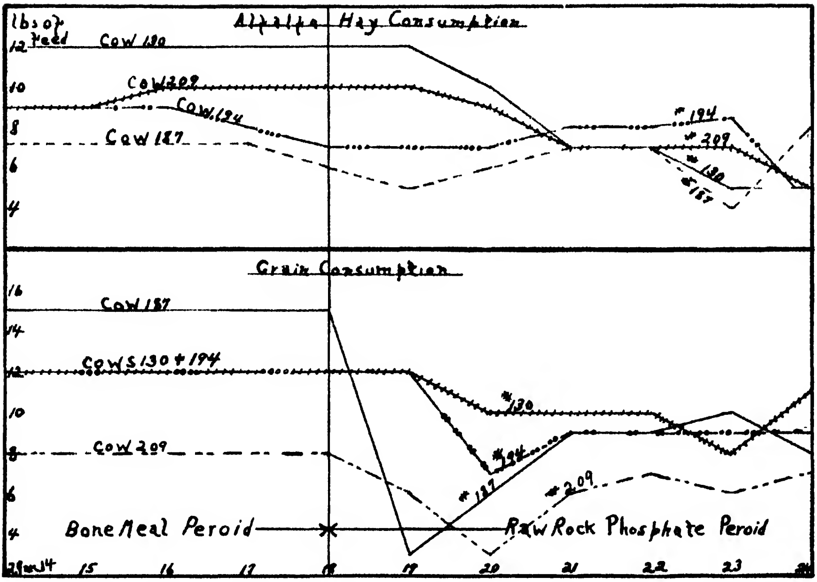


Chart 1.- Showing effect of replacing steamed bone meal with high grade raw rock phosphate on grain and hay consumption.

Commercial Mineral Mixtures as a Source of Phosphorous

Most commercial mineral mixtures on the market do not carry sufficient phosphorus to meet the needs of growing cattle and milking cows when protein concentrates are not fed. During the past few years, we have had numerous inquiries from various sections of Michigan requesting a remedy for depraved appetite in cattle where commercial mineral mixtures were being fed. Most mineral supplements supplying phosphorus are either injurious to the health of the animal or they do not contain sufficient phosphorus. Our experiments indicate that special steamed bone meal, free from odor, is the best mineral supplement supplying phosphorus.

Steamed Bone Meal

Bone meal is not a standard product. There are many different varieties on the market. Raw bone meal is an unsafe feed, since it is usually not heated sufficiently to destroy disease germs. Only special steamed bone meal or bone flour made from bones should be fed to dairy cattle. However, this product may contain an odor which makes it objectionable as a feed. Many cows object to the odor of ordinary fertilizer bone meal. It is, therefore, important to use only an odorless special steamed bone meal. Bone flour made from bones is a safe feed but usually expensive. However, so-called bone flour made from raw rock phosphate is an unsafe feed.

Minerals on Pasture

Although pasture is usually considered the ideal ration, nevertheless, pasture grasses as the sole ration for growing cattle and milking cows do not contain sufficient phosphorus. However, when pasture is supplemented

liberally with such protein concentrates as wheat bran, cottonseed meal, or linseed oil meal, a mineral supplement supplying phosphorus is usually unnecessary. A good mineral mixture to feed on pasture is two parts bone meal to one part salt. Allow free access to this mixture.

YIELDS OF JERUSALEM ARTICHOKE TESTED

Crop Does Not Show Great Promise at Present Time

C. E. CORMANY, FARM CROPS SECTION

The Jerusalem Artichoke (*Helianthus tuberosus L.*) is a close relative of the sunflower, differing chiefly by producing a cluster of tubers just under the surface of the ground and close to the stalk. The top growth is quite similar to the sunflower.

The artichoke has been used to a very limited extent for a spring hog pasture, the tubers furnishing feed when rooted out by the hogs. A few cases are known where the root has been dug and fed to hogs. One muskrat grower is testing this artichoke as a possible source of food for his valuable animals. A few poultrymen are using the vigorous, hardy growing plant as a source of shade for their flocks. It is a source of a small amount of sugars used for medicinal purposes.

Possibilities for Silage

The resemblance of the top growth to the sunflower had led to many inquiries regarding its possibilities as a silage crop, with the roots being left in the soil as a spring hog pasture. It makes a silage very similar to sunflower silage.

The following tables give the yields of various strains of artichokes and the effect of time of harvest on yields at the Michigan Agricultural Experiment Station, season 1926, planted in rows 42 inches apart and spaced 18 inches in the rows.

Table 1.—Yield of green tops of artichokes, 1926 (as a possible use for silage).

Variety	Tons green matter	Per cent dry matter	Tons dry matter
White Improved	9 023	20 3	1.831
U. S. D. A. No. 26719	7 489	24 3	1 819
U. S. D. A No. 26723	9 943	22 5	2.237
Average	8 818	22 4	1.962

The tops were cut September 25th, when the lower leaves had started to turn brown. The plants were then slightly past the full blossom stage. This was thought to be the best stage for silage purposes.

Table 2.—Yield of tubers of artichokes when dug in the fall and spring.

Variety	Yield (tons)	
	Oct. 25, 1926	April 16, 1927
White Improved	6 339	5 989
U. S. D. A. No. 26719...	5 661	6 037
U S. D. A. No. 26723	6 485	6 432
Average	6.162	6.153

Ground Best Storehouse

There seems to be no difference in yield when dug late in the fall after the tops have died down as compared to early spring harvesting. The tubers keep much better, through the winter, in the ground where grown than in the root cellar, being firmer and having less rot than tubers in storage.

Table 3.—Effect of harvesting foliage for silage on the yield of roots the succeeding spring.

Variety	Tuber yield (tons) harvested April 16	
	Tops removed for silage Sept. 25	Tops not removed
White Improved	.918	5 989
U. S. D. A. No. 26719	786	6.037
U. S. D. A. No. 26723	810	6.432
Average	.838	6 153

The yield of roots is greatly decreased by cutting the tops at the silage stage in the fall. The roots make their greatest growth late in the fall, and early harvesting of the tops stops the food supply and kills the plant so no further development is possible. If the roots are desired for spring hog pasture, the tops should not be cut until fully mature.

Conclusions

The Jerusalem artichoke will probably never be of any great importance in America unless a cheap method of extracting the sugars, chiefly inulin, from it is developed. In such case, it may become a valuable source of medicinal sugars. As a silage crop or pig pasture, it is not now recom-

mended, as compared to better adapted crops, smaller yields are secured and harvest costs are higher.

STUDY FEED VALUES FOR PORK PRODUCTION

Rates of Gain on Alfalfa or Rape Pasture Vary Little

W. E. J. EDWARDS AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

These experiments were conducted to study:

1. The value of full feeding versus limited feeding of corn and protein supplements to pigs on alfalfa pasture, and the effect of the two methods of feeding on the longevity of the alfalfa stand, Lots 1 and 2.
2. The value of alfalfa versus rape pasture.
   (a) When the ration consists of shelled corn and protein supplement, Lots 1 and 5.
   (b) When the ration consists of ground barley and ground oats, Lots 3 and 7.
3. The value of shelled corn versus ground barley fed on rape pasture, Lots 5 and 6.
4. The value of ground barley and protein supplement versus ground barley and oats, Lots 6 and 7.

Feeds Used and Methods of Feeding

Lot 1. The animals in this group had access to self-feeders containing shelled corn and protein supplements free choice, on alfalfa pasture.

Lot 2. These pigs were troughfed, twice daily, approximately three-fourths as much shelled corn and protein supplements as were consumed by Lot 1, until Lot 2 averaged approximately 140 pounds in weight; after this, they were self-fed the same feeds. The pigs were on alfalfa pasture.

Lot 3. These pigs had access to ground barley and ground oats, self-fed, free choice, on alfalfa pasture.

Lot 5 had shelled corn and protein supplements, self-fed, free choice, and were on rape pasture.

Lot 6. Ground barley and protein supplements, self-fed, free choice, on rape pasture made up the ration for this group.

Lot 7. This group of pigs had access to ground barley and ground oats, self-fed, free choice, on rape pasture.

The protein supplements used consisted of 60 per cent tankage and old process linseed meal in equal parts by weight.

Each group of pigs was given a mineral mixture composed of 45 pounds steamed bonemeal, 20 pounds finely ground limestone, and 30 pounds common salt. This was self-fed in each case.

Each group of pigs had access to fresh water in an automatic waterer at all times.

A portable cot was placed in each lot for shelter.

Plots 1, 2, and 3 of the alfalfa pasture were cut for hay June 28. Plot 1 produced 2,255 pounds, 925 pounds were obtained from plot 2, and plot 3 produced 2,300 pounds.

Conditions of Pastures

There was little rain in this section during the summer of 1927, and, the alfalfa, especially in plots 1 and 2, was quite dry after August 1. This was the fourth year of pasturing these lots, and the alfalfa was largely replaced

Table 1.—Results of forage experiments conducted in 1927.

	Lot 1	Lot 2	Lot 3	Lot 5	Lot 6	Lot 7
	Sh corn, tankage, linseed meal, minerals, self-fed, free choice	Sh. corn, tankage, linseed meal, ¾ ration, trough fed, minerals, self-fed	Gr. barley, gr oats, minerals, self-fed, free choice	Sh corn, tankage, linseed meal, minerals, self-fed, free choice	Gr barley, tankage, linseed meal, minerals, self-fed, free choice	Gr. barley, gr. oats, minerals, self-fed, free choice
Kind of pasture	Alfalfa	Alfalfa	Alfalfa	Rape	Rape	Rape.
Area of pasture	1 acre	1 acre	1 acre	1 acre	1 acre	1 acre
Number of pigs per lot	15	15	15	15	15	15.
Feeding period	June 17 to Oct 14	June 17 to Nov. 1	June 17 to Oct 16	June 17 to Oct 11	June 17 to Oct 23	June 17 to Oct 23.
Av. initial weight	51 80	52 67	52 86	52 26	51 80	52 20
Av. final weight	203 64	202 93	200 71	204 67	208 07	204 63
Av daily gain per pig	1 234	1 074	1 222	1 314	1 182	1 191
Av daily feed consumed:						
Shelled corn	4 003	3 548		4 168		
Ground barley			3 877		4 574	3 613
Ground oats			1 755			1 791
Tankage	192	164		294	222	
Linseed meal	192	.164		294	222	
Minerals	006	005	022	006	006	025
Total	4 393	3 881	5 654	4 762	5 024	5 429
Feed required for 100 lbs gain						
Shelled corn	324 60	330 38		317 27		
Ground barley			317 23		380 89	303 32
Ground oats			143 61			150 33
Tankage	15 54	15 28		22 40	18 78	
Linseed meal	15 54	15 28		22 40	18 78	
Minerals	508	459	1 813	437	533	2 143
Total	356 19	361 40	462 65	362 51	424 98	455 79
*Cost of feed per 100 lbs. gain:						
Shelled corn	$5 68	$5 78		$5 55		
Ground barley			$5 55		$6 77	$5 31
Ground oats			2 51			2 63
Tankage	54	53		78	66	
Linseed meal	43	42		62	52	
Minerals	007	007	027	006	008	032
Total	6 66	6 74	8 09	6 96	7 96	7 97
With corn, barley, and oats at $1.50 per cwt.	5 85	5 92	6 94	6 17	6 98	6 84
With corn, barley, and oats at $2.00 per cwt.	7 47	7 57	9 24	7 75	8 92	9 10

*With the following feed prices: corn, barley, and oats at $1.75 per cwt., tankage at $3 50 per cwt., linseed meal at $55.00 per ton and minerals at $30.00 per ton.

by June grass before the end of the season. There was an abundance of alfalfa in plot 3 throughout the season. This was the third season of pasturing on plot 3. Plots 5, 6, and 7 provided a succulent growth of rape throughout the entire feeding period.

Summary

The cost per hundred weight of gain was practically the same with both the full fed hogs and those fed a limited ration. The full fed hogs, Lot 1 were ready for market 18 days ahead of Lot 2 fed a limited ration. This saved considerable labor and would usually place them on a higher market.

There was likewise very little difference either in the rate of gain or the total amount of feed required to produce 100 pounds of gain on alfalfa or rape pasture. The only significant difference between the two lots is that the pigs on rape consumed slightly more protein supplement. This added somewhat to the cost of 100 pounds of gain, Lots 1 and 5.

There was also practically no difference in the value of alfalfa and rape pasture when the ration consisted of ground barley and ground oats, Lots 3 and 7.

Shelled corn and protein supplement fed on rape pasture showed a much smaller feed requirement for 100 pounds gain, a more rapid daily gain, and a lower cost per 100 pounds of gain than did Lots 5 and 6 fed ground barley and protein supplements on rape pasture.

The daily gains produced by ground barley and protein supplements were practically the same as those produced by ground barley and ground oats. The feed requirement for 100 pounds of gain was somewhat less with the ground barley and protein supplement, although the higher priced protein supplement made the cost per hundred weight of gain practically the same as with ground barley and ground oats when these grains were charged at $1.75 per hundred weight and tankage at $70.00 per ton. With barley and oats at $1.50 per hundred weight, the cost was somewhat less where no protein supplement was used. With barley and oats at $2.00 per hundred weight, the barley and protein supplement produced somewhat cheaper gains, Lots 6 and 7.

Both alfalfa and rape pasture proved highly satisfactory for growing fattening pigs. The advantage of alfalfa pasture lies in the fact that the grazing season is longer and that it is not necessary to seed the alfalfa each year as is the case with rape.

The figures of this experiment will enable the feeder to determine the feed cost per 100 pounds of gain produced under various conditions and with different feeds. It should be borne in mind that the feed cost is approximately 80 per cent of the total cost of producing pork.

WALNUT INTERPLANTED WITH CEDAR GROWS RAPIDLY

Height-Growth Forced by Shade-Loving Species

. BY PUTNAM W. ROBBINS, FORESTRY SECTION

An experimental planting of light-demanding, fairly rapid growing trees and slow growing, shade-tolerant trees on an area of heavy soil was started at Michigan State College in 1910.

Approximately 1 acre, adjoining one of the college woodlots in 1909, was cleared and a tile drain was laid to take care of the surplus water on that portion of the area which was inclined to be wet. The plot was plowed during the previous fall and prepared for planting during the spring of 1910. The soil on the area is a moist, heavy muck on the lower portions and gradates to sandy loam on the highest portion of the plot.

One-year-old black walnut seedlings and four-year-old white cedar transplants were used in the planting. A four by four foot spacing was used throughout the plantation. The black walnuts were spaced four feet apart in the rows and eight feet apart between rows; the alternate rows were white cedar, spaced four feet apart in the row. Approximately 956 black walnut and 956 white cedar were planted on the plot. The plot was cultivated the first year, and the weeds were cut with a scythe the following two years.

Characteristics of Walnut

Black walnut is a long-lived light-demanding species and often requires a thinning a few years after it is planted unless it is planted with a wide spacing, for example, 8 by 12 feet. Such wide spacing is unnecessary if a shade bearing tree is alternated with the black walnut. In this plantation, white cedar which is a tolerant, slow-growing tree was alternated with the black walnut in order to fully utilize the ground and to aid in shading the ground. This destroys weed growth and stimulates the height-growth and self-pruning of the black walnuts.

The black walnuts had begun to compete for light in 1915, and the white cedar were no longer needed. Accordingly, most of the white cedar were removed. The competition for light has been so severe that many trees have died and only 478 black walnuts remain of the original 956. Thus, although the stand has never been thinned it appears to have been, for, only in a few places, are the trees still spaced 4 feet apart in the rows.

Table 1 gives the number of trees by diameter and the volume of the stand in 1928, 18 years after planting.

The volume per tree in cubic feet, shown in table 1, was computed from a volume table for mixed hardwoods of southern Michigan. The volume shown in the table includes cordwood in the tops and branches.

There are approximately 90 cubic feet of solid wood in a cord; therefore, the plot contains 14.25 standard cords.

The area of the plot is .83 acres. Thus the average growth per acre per

Table 1.—Volume of black walnut plantation.

Diameter 4½ feet above ground	Number of trees	Volume per tree cubic feet	Total volume cubic feet
2	49	4	19 6
3	73	8	58 4
4	115	1 5	172 5
5	121	3 0	363 0
6	81	4 6	372 6
7	30	7 0	210 0
8	8	9 5	76 0
9	1	12 6	12 6
Total	478	......	1,284 7

year would be .95 standard cords. This rate of growth is rapid in view of the fact that the average Michigan woodlot is producing not more than half a standard cord of wood or its equivalent in board feet per acre per year.*

The trees have made the most rapid growth on the moist muck soil in the area drained by the tile. Natural thinning has taken place and self-pruning has left clean stems 20 feet long in this part of the plot.

Soil Conditions

The highest portion of the plot runs out of the muck into sandy loam soil, and, in this area, the poorest growth has been made by the black walnuts. The few cedars which remain on this part of the plot have done well because they received more light and had little root competition from the black walnuts. The average height of the black walnut trees over the entire area is 39 feet. The white cedars vary from three to 16 feet in height, with an average of approximately five feet.

The black walnut has demonstrated clearly that it is a light-demanding species and that thinnings at an early age are necessary, unless the plantation is established with a wide spacing. If a wide spacing is used, the black walnut will require pruning of the lower branches until the crowns close, in order to secure clean, straight stems.

Experimental Results

From the results of this experimental plot, it would seem to be more advisable to use a shade-bearing species as the alternate trees in the plantation, rather than to use all black walnuts in the original planting. It will be profitable to use white cedar or spruce as the alternate planting stock since they may be removed and sold for ornamental purposes as soon as they have fulfilled their purpose of stimulating rapid height-growth and self-pruning of the black walnuts, and the walnuts may then be left to finish their growth alone. It would seem to be more advisable to use a spacing of six by six feet for the entire plot rather than four by four feet as was used in this plantation. It, also, appears advisable to alternate a shade-bearing tree such as white cedar in each row rather than have alternate rows of a shade-tolerant species. Thus, when the tolerant species are removed, the

*"Improvement of the Farm Woodlot," by A. K. Chittenden, Michigan State College, Special Bulletin No. 122.

walnuts will have a spacing of 12 by 12 feet, and would not require thinning for some time.

Black walnut will seldom restock an area by natural seeding. Planting must be resorted to in order to have a second crop of walnut trees on the area. On this sample plot, elm and black cherry reproduction are invading the plot along the edges which border the woodlot, the seed having blown in from neighboring elm and cherry trees.

If the plantation is to produce saw timber, it should be thinned when the trees begin to crowd. If the object is the production of posts, it will take 25 to 30 years since the trees must have time to mature a considerable amount of heartwood because walnut with a large amount of sapwood does not make first class fence posts. A black walnut plantation, however, will produce the greatest returns when grown for saw timber.

SEED POTATO DISEASE CONTROLS COMPARED

Corrosive Sublimate Gives Best Results in 1927 Experiments

H. C. MOORE AND E. J. WHEELER, FARM CROPS SECTION

Bayer Dip Dust, Semesan Bel, and other organic mercury seed disinfectants were compared with corrosive sublimate for control of scab and black scurf. The tests were conducted at Michigan State College and at Lakeview, Montcalm county. The results here given of one seasons tests are not regarded as conclusive, but are published at this time in response to numerous inquiries from growers concerning the relative merits of the organic mercury seed treatment compounds.

Methods of Treatment

Irish Cobbler potatoes seriously affected with scab and black scurf were divided into 13 lots. Lot No. 1 was not treated and was used to plant the four check plots.

Lot No. 2 was treated with Bayer Dip Dust by the instantaneous dip method. Just previous to planting, the uncut seed was dipped into a solution of one pound of Bayer Dip Dust mixed with 20 pints of water. The seed was thoroughly covered with the solution then taken out and allowed to dry before planting.

Lot No. 3 was treated with Semesan Bel at the rate of one pound of the disinfectant to 20 pints of water. The method of treatment being the same as for lot No. 2.

Lots No. 4 to 12 inclusive were treated with organic mercury compounds furnished by the Du Pont Company. These compounds are designated as 12 Bel; 21 Bel and 37 Bel and were used at concentra-

tions of one pound to ten pints, 1 to 15; 1 to 20 and 1 to 30. The method of treatment was the same as for lots No. 2 and 3.

Lot No. 13 was treated with corrosive sublimate, four ounces to thirty gallons of water for thirty minutes. The seed was treated before it was cut and just previous to planting.

Time of Planting

The seed was planted June 6 in single row plots 60 feet long replicated twice. The soil was a sandy loam of medium fertility and was evidently infected with scab and black scurf as all plots showed high percentages of these diseases. Furthermore, an adjacent plot planted with Russet Rural seed apparently free from scab and black scurf was treated with corrosive sublimate and produced seed infected with scab and scurf.

The rainfall for June, July, and August was 3.81 inches, (5.44 inches below normal) which was not sufficient to produce high yields of Irish Cobblers.

Notes made during the growing season did not show any significant difference between the plots in per cent of stand or vigor of plants. The plots were harvested October 25. Yields were recorded and counts were made on percentages of scab and black scurf, the results are given in Table 1.

Table 1.—Seed treatment experiment, M. S. C., 1927.

Lot No.	Seed treatment	Clean of scab, per cent by weight	Clean of black scurf, per cent by weight	Yield per acre bushels
1	Ck. (untreated)	25 55	6.81	59 43
2	Bayer Dip Dust	47 30	11 23	53 28
3	Semesan Bel	44 74	15 02	59 44
4	12 Bel (1-10)	42 97	15 73	58 67
5	12 Bel (1-20)	43 03	26 83	61 84
6	12 Bel (1-30)	31 35	12 38	70 49
7	21 Bel (1-15)	58 43	31 50	70 79
8	21 Bel (1-20)	55 93	33 76	71 18
9	21 Bel (1-30)	42 41	34 29	75 31
10	37 Bel (1-10)	32 75	31 28	58 53
11	37 Bel (1-20)	31 80	14 08	63 58
12	37 Bel (1-30)	27 87	18 24	56 07
13	Corrosive sublimate	49 27	44 49	67 27

Lakeview Test

The seed treatment experiment at Lakeview was conducted the same as the Michigan State College experiment. An organic mercury compound, 2 Bel was substituted for 21 Bel and the 37 Bel (1 to 30) and 12 Bel (1 to 30) were omitted.

Russet Rural seed affected with black scurf but apparently free from scab was planted June 15th in single row plots 60 feet long, replicated twice. The soil was a fertile sandy loam. Rainfall during the growing season was approximately 1.17 inches below normal. All plots showed approximately the same per cent of stand and the same relative vigor of vine growth. However, one plot planted with seed treated with 12 Bel (1 to 15) solution had a number of weak hills which could not be accounted for by the seed treatment.

The plots were harvested October 14 and yields and percentage of potatoes affected with black scurf were calculated. All plots were apparently free of scab, so no counts were made for the percentage of scabby tubers. The results of this test are given in Table 2.

Table 2.—Seed treatment experiment, Lakeview, 1927.

Lot No.	Seed treatment	Clean of black scurf, per cent by weight	Yield per acre bushels
1	Check (untreated)	46 00	144 62
2	Bayer Dip Dust	92 56	151 09
3	Semesan Bel	92 83	145 47
4	12 Bel (1-10)	93 75	156 25
5	12 Bel (1-15)	88 18	131 10
6	2 Bel (1-10)	81 14	158 39
7	2 Bel (1-20)	73 54	156 90
8	2 Bel (1-30)	65 82	153 35
9	37 Bel (1-10)	96 27	156 81
10	37 Bel (1-15)	95 75	157 01
11	Corrosive sublimate	99 52	144 96

Comparison of Data

The results of the foregoing tests indicate that corrosive sublimate was fully as effective as Bayer Dip Dust and Semesan Bel in the control of scab and more effective than these two compounds in the control of black scurf. No significant difference in per cent of stand, vigor of plants, or yield was noted between the corrosive sublimate plots and those treated with Bayer Dip Dust and Semesan Bel.

None of the other organic mercury treatments were as effective in the control of black scurf as the corrosive sublimate and only two, 21 Bel (1 to 15) and 21 Bel (1 to 20) showed as satisfactory control of scab as did the corrosive sublimate.

While some of the organic mercury treatments gave better yields than the corrosive sublimate, yet the difference in yield is of little significance. In the Michigan State College tests, the average yield per acre of the 11 organic mercury treatments was 63.38 bushels or 3.89 bushels less than the corrosive sublimate plots. In the Lakeview tests, the average yield per acre of the nine organic mercury treatments was 151.82 bushels or 6.86 bushels more than the corrosive sublimate treatment.

Further experimental work is necessary before definite conclusions can be drawn or recommendations made. The 1927 tests indicate, however, that Michigan growers are not yet warranted in substituting organic mercury compounds for corrosive sublimate in the control of black scurf. In Michigan, black scurf is more serious than scab in causing losses to the potato crop.

Detailed directions for the treatment of seed potatoes with corrosive sublimate are given in Special Bulletin 125 and Extension Bulletin 49 of the Michigan State College.

COMPUTING RETURNS FROM A FOREST PLANTATION

Land Costs Are Principal Factor in Determining Profits

BY A. K. CHITTENDEN, FORESTRY SECTION

In establishing a forest plantation, there are often several considerations that influence the owner, some of which may be of more importance than the financial returns. The beautification of the landscape, the utilization of idle land, or the effect of the plantation as a windbreak or shelter may be the principal consideration. Yet the future financial returns are always of importance and are often the main thought back of the plantation. A forest plantation is a long time investment, the land and money are tied up for a considerable period, and, for this reason, compound interest should be used in calculating costs.

Interest or land rent should be charged against the plantation while it occupies the land. Similarly, the cost of planting and taxes should be figured at compound interest. For this reason, it is desirable to use land of not too high value and to keep the planting cost low since money increases rapidly at compound interest.

If the trees are planted six by seven feet apart, about 1,000 trees are needed per acre. If small seedlings are used, the cost of the planting stock will be about three dollars per 1,000 and the cost of planting should not exceed six dollars per acre, or a total for trees and planting of nine dollars per acre.

Production Costs

If the land costs, or is worth, 40 dollars per acre and the taxes are 50 cents per acre per year and the species planted is white or red pine, requiring 40 years to produce small saw logs, the costs would be as follows, using five per cent compound interest.

Cost of trees and planting, nine dollars for 40 years at five per cent	$63.36
Land rent—Interest on $40 for 40 years at five per cent	241.60
Taxes—50 cents per year for 40 years at five per cent	60.40
Cost at end of 40 years	$365.36

At the end of 40 years, a white or red pine plantation should yield 25,000 board feet per acre on a good quality of soil, worth at least $15 per thousand board feet, or $375 per acre, thus making almost exactly a five per cent investment, since all money spent has earned five per cent interest.

It will be noted that the principal item of cost is the land rent. If

cheaper land is used, the costs will be much less. If the land on which the plantation is established would otherwise be idle, has no sale value, or is worth little, this item of cost would be small, and the saving in land rent would appear as a profit at the end. The taxes would also be less.

A shorter period plantation, such as a Christmas tree plantation, or one used for pulpwood, will accumulate less costs because the number of years for which the money is to be compounded will be less.

Size of Trees Used

The size and cost of the planting stock used greatly influences the final cost of the plantation. Each dollar invested at the beginning amounts to seven dollars at five per cent compound interest in 40 years. For this reason it is best to use small seedlings as they cost less than larger trees and can be planted more cheaply. It does not pay, however, to use too small trees or to plant them carelessly in order to avoid expense as they might not succeed as well as larger trees, in which case the final yield of timber would be reduced.

While forest plantations do not bring in quick returns, they should earn a good rate of interest on the money invested and they produce returns from land which might otherwise be idle.

PROGRESS SHOWN IN POTATO SEEDLING SELECTION

Effort Made to Discover Varieties Suitable for Commercial Production

BY C. E. CORMANY, FARM CROPS SECTION

Many of our best potato varieties are the product of naturally fertilized potato seed balls. Some varieties of potatoes seldom produce seed balls which contain seed which will germinate and grow under Michigan conditions. Included in this group are Rural, Early Ohio, Triumph, and Burbank varieties, but the Green Mountain and Cobbler produce abundant seed.

Potatoes grown from seed show great variation and make an interesting study in selection. In the fall of 1924, seed was collected from disease-free Green Mountain potato vines and in 1925 from Cobblers. From this start, many strains have been developed and are now being tested.

The method used in testing was to plant the seed in plats in the greenhouse in April and transplant to the field in early June after frost danger was past. The germination of potato seed is low, and the mortality of the young seedlings is great. In April, 1926, 5,775 seeds of the Cobbler variety were planted in the greenhouse, from which 2,817 small plants were grown. Between June 12 to 14, 2,546 of these

plants were transplanted to the field. Many of the seedlings perished, and in October 530 remained. These were harvested, stored, and planted June 10, 1927, in an increase plat. During the growing season any that were undesirable in plant growth or were suspiciously diseased or weak were dug out and thrown away, leaving 406 Cobbler seedling increases in October, 1927.

Data was taken on the tubers of these in January, and 140 of the best type tubers were kept. In selecting these 140 tubers, field notes relative to vine growth were also consulted, thus insuring a good type plant as well as tuber.

Fig. 1.—Section of field of Green Mountain seedlings during season of 1927. A wide variation in top growth is apparent.

The increases of these 140 Cobbler seedlings as well as the Green Mountain seedlings produced in the same manner will be again planted, in rows, thus affording a further means of study and selection and furnish enough tubers for a yield test of the most promising seedlings. The tubers produced the first year are generally small and many are irregular in shape. However, with large number of seedlings, it was possible to select only the best type.

The vine growth is quite variable also; some are upright, others spreading, and a few entirely decumbant. In many cases the tubers formed the first year were near the surface of the ground and became sunburned easily.

The tubers produced from the first year's tubers were larger and quite like the average potato crop in size and yield, but the plants showed great variations both in top growth and tubers. It was in the second year seedlings that the greatest amount of selection was pos-

sible. A wide variation in date of maturity was also noted. Selection work with promising strains is being continued at the Michigan Experiment Station.

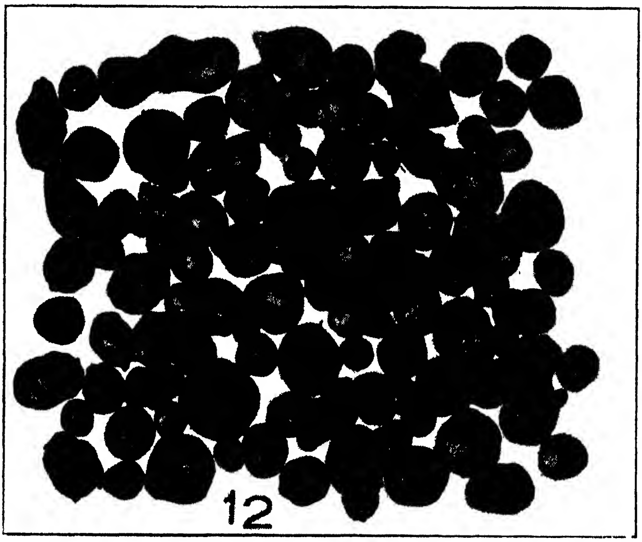


Fig. 2.—Cobbler seedling showing an abundance of small tubers formed the first year—not promising and discarded the second year.

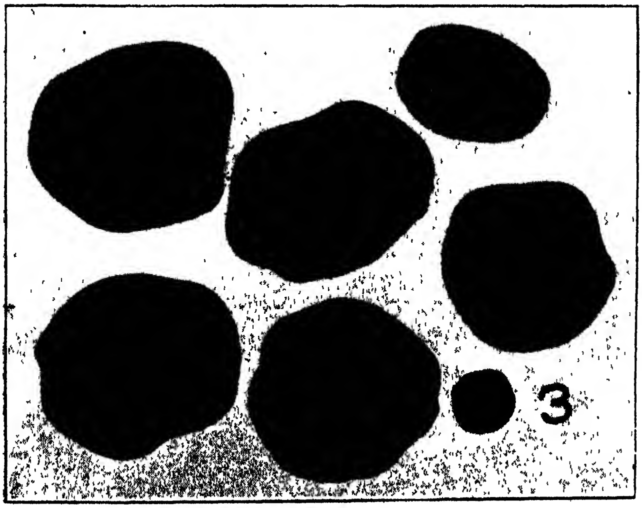


Fig. 3.—A first year Cobbler seedling which proved very promising.

COMPARATIVE YIELDS OF ROOT CROPS TESTED

Roots May Serve as Substitutes for Silage in Dairy Rations

BY C. E. CORMANY, FARM CROP SECTION

For the farmer who has no silo and yet wishes a succulent feed for his cattle during the winter months, the root crops offer a solution to his problem.

The various root crops yield well and when properly stored, either in pits or the root cellar, keep well. Considerable personal preference goes into the selection of the kind of root to be grown. In Michigan, farmers prefer the mangel group, with the Mammoth Long Red variety leading, followed by the Danish Giant Sludstrup. The Giant Feeding Holy Sugar Mangel is comparatively new and is rapidly winning its way. In our tests, we have found it a great yielder. It is claimed that it contains more sugar than the other mangels and, hence, has a greater feeding value.

Turnips and rutabagas vie for second place in the opinion of feeders of roots. The turnip has been found to outyield the rutabaga. Carrots are grown chiefly as a special feed and are not so important as the others mentioned, although they yield slightly better. A few

Results with miscellaneous root crops for the years 1924-1925-1926.

	Average size pounds	Average per cent yield compared to check	Average yield tons per acre
Check (sugar beet)	1 063	1	13 911
Giant feeding half sugar mangel	1 908	1 558	21 673
Danish giant sludstrup mangel	1 586	1 482	20.616
Kirsches Fodder mangel	1 921	1 471	20 463
Mammoth long red mangel	1 792	1 449	20.157
Amber globe turnip	1 082	1 340	18.640
Cowhorn turnip	1 022	1 278	17.778
Maud's carrot	735	1 250	17 389
Oxheart carrot	645	1 178	16 387
Mammoth or tankard rutabaga	1 480	1 110	15.441
Golden tankard mangel	1 357	1 084	15 080
Bangholm rutabaga	1 371	934	12 993
Halflong drak red beet or halflong blood beet	1 037	913	12 701
Am. purple top rutabaga	936	795	11 059
Average of Groups			
1—Mangel	1 705	1 409	19 601
2—Turnip	1 052	1 309	18 209
3—Carrot	.690	1 218	16.943
4—Rutabaga	1 262	9.46	13.160
5—Garden beet	1 037	9 13	12.701

feeders are using the sugar beet and the large garden beet for feeding purposes.

Storage Qualities

In storage, the carrot has kept best, followed closely by the various mangels and sugar beets. The rutabaga and turnip seemed to break down and decay much sooner than the others.

Broadcasting the seed is the rule when sowing turnips and rutabagas, but, for this experiment, the seed was planted in rows which were two feet apart. The mangels and rutabagas were spaced twelve inches apart in the rows, the beets ten inches, the turnips eight inches, and the carrots seven inches. All were thinned and cultivated at the same time. The mangels, beets, and carrots were planted about the middle of May and the turnips and rutabagas about June 10.

From the results obtained, it seems that the mangel is our best root crop to grow for winter feeding to live stock. It outyields the others and keeps considerably better in storage.

LEAF-HOPPERS AND APHIDS EASILY CONTROLLED

Contact Sprays Recommended to Stop Attacks On Shrubs

BY E. I. MC DANIEL, ENTOMOLOGICAL SECTION

The rose leaf-hopper, *Empoa rosae,* is an European insect which is believed to have found its way into America on nursery stock. Today it is distributed throughout the United States and infests practically all our deciduous trees and shrubs, though it shows a decided preference for members of the rose family which includes our northern tree fruits.

This insect produces two generation a year, and passes the winter in the egg stage. Each egg is thrust into a tiny hole bored into the tender bark of one of its numerous hosts. The insect undoubtedly owes its wide distribution to the fact that its winter eggs are so well protected and difficult to detect, that cuttings, scions, and nursery stock may serve as carriers, without the knowledge of the owner.

The eggs hatch about the time that the leaf buds open, and the young nymphs collect on the new leaves, where they feed for a time unobserved. When they are present in any considerable numbers, enough sap is removed from the foliage to cause it to appear pale and perhaps to drop prematurely. The injury caused by the members of the first generation is more pronounced than that of the mid-summer brood, since the latter have a larger and more mature leaf surface on which they feed. The eggs of the first generation are deposited in the larger veins of the leaves.

Leaf-hoppers are always more abundant in dry hot seasons, and when

they have been in a garden for several successive years it is safe to depend on their presence in years to follow.

Plant-lice

Plant-lice or aphids are always more plentiful in cold damp seasons. Most of the aphids in this region pass the winter in the egg stage. Many species have a separate winter host, usually some deciduous tree or shrub. *Illinoia solanifolii*, a species perhaps better known as the potato aphid, passes the winter on rose, and the first two or three generations remain on the rose. In early summer, providing the weather is warm, winged forms appear which disperse to summer hosts.

When present on rose in large numbers, growth is stunted and the plant is covered with a "sooty fungus" which grows on the excess honey dew excreted by the aphids.

Control

All the species under discussion are sucking insects and their control demands the use of a contact spray. Sprays should be applied as soon as the insects appear in numbers and before the immature forms become winged, since winged individuals fly away on the slightest disturbance. There are several effective contact sprays, of which nicotine is probably the best known. It should be applied at standard strength:

1 oz. ....40 per cent nicotine sulphate
6 gals ....water
1 oz. ....cheap laundry soap

The spray should be applied with considerable force since only the insects that are hit, are killed.

Under proper conditions and with the right dust, good control of both leaf-hoppers and plant-lice may be obtained by the use of nicotine dust. If the dust is fresh and has been kept in a tight container, a two per cent strength should be sufficient.

Among the other better known contact sprays are Derrisol and some of the Pyrethrum extracts. With these, as with nicotine, each insect must be hit to be killed.

CELERY BLIGHT CONTROL MEASURES COMPARED

Dusting and Spraying Tested In Kalamazoo Experiments

G. H. COONS, RAY NELSON, AND E. A. WALKER, BOTANICAL SECTION

The relative merits of dusting and spraying for the control of the late blight of celery *(Septoria apii)* have been frequently discussed by the muck farmers of Michigan. The demand for thorough, comparative tests

of these two types of control measures led the plant pathology section of the department of botany at Michigan State College to carry on tests at Kalamazoo during the 1927 season.

While there are two other leaf diseases of celery causing more or less damage to the Michigan crop, namely, early blight *(Cercospora apii)* and bacterial leaf spot *(Bacterium apii)*, the greatest need in celery culture is successful control of the late blight. Any measures reasonably effective against the Septoria disease will control the minor leaf diseases as well.

Characteristics of Disease

The late blight of celery is characterized by the spotting of the leaflets, and these spots can be recognized by the pepper-like dots which are always present in the older spots. The disease is caused by a fungus which grows in the leaf tissue and causes it to decay. The fungus also attacks the leaf stalks and produces extensive brown areas upon them. Blighted celery rots badly in storage and under transportation conditions so that it is unsafe to hold in cold storage or to ship for long distances.

For a fuller description of this disease, the reader is referred to Special Bulletin 77 of the Michigan Station. In this bulletin, spraying with Bordeaux mixture was shown to control late blight under Michigan conditions.

Spraying, especially for growers with small acreages, is a rather laborious operation. The one to three acre field is frequently neglected rather than to resort to the laborious task of putting on spray mixtures with a hand sprayer. In the larger celery fields where horses are employed for other cultural operations, a horse-drawn sprayer can be used on the muck if the outfit is equipped with wheels having wide tires. The great advantage of the liquid application over the dust comes from the greater economy of the former. It is cheaper to use Bordeaux mixture than the dust fungicides.

The dust fungicide, although more expensive for the materials used, possesses the advantage of convenience, ease of application and speed with which it may be applied. The duster is lighter than the corresponding type of spray outfit and is more likely to be used than the heavier spray machine.

Many growers have questioned which of the control measures is most efficient. The tests reported from other states have not been carried out for a period long enough to answer all questions. Few if any of the tests have been carried on during severe epidemic conditions. The problem is of such a sort that tests over many seasons are needed to evaluate the two methods properly.

Tests Made at Kalamazoo

The following test was carried on at Kalamazoo, Michigan during the 1927 season in co-operation with Mr. John Kline and the Kalamazoo State Hospital. The field which was dusted consisted of two acres of the tall strain of Golden Self Blanching celery with the rows spaced about four and one-half feet and each row approximately 100 rods in length. The duster used was the latest power type, equipped

with a self-mixing device permitting the use of basic materials. It was loaned for the test through the courtesy of the Bean Spray Pump Company, of Lansing, Michigan.

The applications were made in the early morning while the plants were still moist with dew. A standard commercial factory-mixed dust was compared with dust made from basic materials mixed in the hopper of the power duster just previous to application. The efficiency of these dusts was compared with standard Bordeaux mixture of the 5-5-50 formula.

The extremely dry season interfered seriously with the test, since no leaf disease developed until the middle of September. Following the exceptionally rainy fall weather, late blight began to cause considerable damage, and its presence was so general and the outbreak so typical of what ordinarily occurs in August that we feel safe in the interpretation we are giving to the figures obtained in this experiment.

Control Shown

Examination of the field from October 1st until harvest (Oct. 14) showed that blight control was excellent upon the sprayed and the dusted rows. The striking difference between the treated rows and

Results of spraying and dusting test at Kalamazoo, Mich. in the season of 1927. Four applications for each treatment. Counts of blight spots made October 14, 1927.

Row	Treatment	Detail of blight spots per random sample leaf	Average
1	Machine-mixed, copper sulphate—lime dust, 20-80	0, 54, 0, 4, 4, 0, 2, 4, 1, 4	7 3
2	Same	1, 1, 0, 0, 0, 2, 0, 1, 1, 1	0 7
3	Same	7, 2, 4, 1, 0, 8, 1, 1, 4, 2	3 0
4	Untreated	58, 843, 48, 235, 50, 112, 450, 100, 90, 135	212 1
5	Commercial-mixed copper sulphate—lime dust, 15-80	1, 1, 25, 6, 0, 5, 4, 6, 0, 0	4 8
6	Same	No record taken	....
7	Same	24, 20, 1, 0, 11, 4, 13, 13, 8, 0, 4	9 0
8	Untreated	147, 67, 63, 215, 540, 58, 160, 70, 164, 94	157 8
9	Bordeaux mixture 5-5-50	2, 0, 13, 25, 30, 1, 1, 10, 0, 16	9 8
10	Untreated	650, 84, 60, 1700,* 180, 1616,* 25, 434, 115, 7	487 1

*Estimated.

Notes on Treatments

The machine-mixed dust was made by placing 12½ pounds of monohydrated copper sulphate and 50 pounds of hydrate lime in the hopper of the duster and mixing by means of the special agitator within the hopper. The monohydrated copper sulphate cost approximately $15 per cwt.

The commercial mixed dust was the standard dust and was obtained from the Niagara Sprayer Company

The rate of application for the dusts was 35 pounds per acre per application.

The Bordeaux mixture was applied with a knapsack sprayer at the rate of 100 gallons per acre per application.

the untreated check rows was evident even on casual examination. The blight attack was confined to the older leaves which would be trimmed off at marketing time so that no comparison could be obtained from the ordinary harvest data. To get a numerical measure of the value of the methods employed, random samples of leaves were taken along the various rows and the actual number of blight spots counted. In a few instances where the numbers were extremely large, it was necessary to estimate the number of spots on representative leaflets. The results of the counts are shown in the following table and it is believed that the average number given shows fairly accurately the relative efficiency of the treatment.

We do not wish to go too far in drawing conclusions from these data. It is obvious that, under the conditions of this test, the dusts used have been as effective as the standard spray material, Bordeaux mixture. The dusted celery would have been as safe to store as the sprayed and each would have been vastly safer for storage purposes than that from the unsprayed rows. It must be borne in mind that the interspersing of check rows, which were a constant source of inoculum, made control of blight by either method more difficult. We look upon the performance of the horse-drawn duster as extremely promising in the control of late blight.

FIND DISINFECTANTS SLIGHTLY AFFECT EGGS

Incubating Qualities of Eggs Not Seriously Injured in Experimental Trials

BY J. L. BOYD, POULTRY SECTION

To determine if the use of disinfecting solutions had any detrimental effects on the hatching qualities of eggs, 700 eggs were divided into five groups of 140 eggs. Each group of 140 eggs was further subdivided into sub-groups of 35 eggs each. Only one disinfectant was used on each particular group. The sub-groups were given different degrees of treatment with the same disinfectant.

Uniform Groups Used

In order to get as uniform groups of eggs as possible from the standpoint of fertility and hatchability, the eggs were pedigreed and one egg from each hen was placed in each group. White Leghorn, Barred Rock, and Rhode Island Red eggs were used for this experiment, and the eggs of each breed were divided equally among the five groups.

The first 35 eggs of each group were immersed in the disinfecting

solution, immediately removed, and placed on the trays. The second 35 eggs were immersed for a period of one minute. The third sub-group was immersed for a period of three minutes, while the fourth sub-group was sprayed with the solution while the eggs were on the tray before incubation started. All eggs were incubated in the same machine and were under the same conditions except for the disinfectant used.

Various Solutions Tested

The following sub-groups were immersed in their respective disinfecting solutions and immediately removed:

	Sterilac	Sodium hypochlorite	Iodine suspensoid	Chlorinated lime	Check
Egg numbers	1-35	141-175	281-175	421-455	561-595
Infertile	8	9	8	2	6
Dead germ	3	3	0	2	0
Broken	1	0	0	3	1
Dead-shell not pipped	3	0	5	2	2
Dead-shell pipped	0	1	0	1	0
Cripples	1	1	1	1	1
Good chicks	19	21	21	24	25

The following sub-groups immersed for one minute.

	Sterilac	Sodium hypochlorite	Iodine suspensoid	Chlorinated lime	Check
Egg No	36-70	176-210	316-350	456-490	596-630
Infertile	8	4	9	9	7
Dead germs	4	1	3	2	1
Broken	0	2	0	2	0
Dead-shell not pipped	3	3	3	2	1
Dead-pipped	0	0	0	1	0
Cripples	1	2	1	0	2
Good chicks	19	23	19	19	24

The following sub-groups immersed for three minutes.

	Sterilac	Sodium hypochlorite	Iodine suspensoid	Chlorinated lime	Check
Egg No.	71-105	211-245	351-385	491-525	631-665
Infertile	2	3	4	6	5
Dead germs	4	10	7	2	2
Broken	1	2	0	6	1
Dead-shell not pipped	5	4	2	3	2
Dead-shell pipped	0	1	0	0	0
Cripples	1	1	1	1	0
Good chicks	22	14	21	17	25

The following sub-group sprayed on incubator trays before incubation.

	Sterilac	Sodium hypo-chlorite	Iodine suspen-soid	Chlori-nated lime	Check
Egg No	106–140	246–280	386–420	526–560	666–700
Infertile	5	6	3	12	10
Dead germs	5	2	3	2	1
Broken	0	3	0	0	0
Dead not pipped	3	4	2	0	1
Dead pipped	0	0	1	0	1
Cripples	2	2	0	0	2
Good chicks	20	18	26	21	20

While more work is necessary to confirm or disprove the conclusions which may be drawn from the above data it appears that dipping hatching eggs in disinfecting solutions has a slight detrimental effect on their hatchability.

The check group showed a hatchability of 67.1 per cent, sodium hypochlorite solution 54.3 per cent, sterilac 57.1 per cent, Iodine Suspensoid 62.1 per cent, and chlorinated lime 57.1 per cent.

The total of infertile eggs in each group indicates that fertility was quite constant throughout, the high point being 29 out of 35 in the chlorinated lime group, 28 in the check group, 23 each in the Sterilac and Iodine Suspensoid group, and 22 in the Sodium hypochlorite group.

Dead Germs More Numerous

Dead germs were somewhat more numerous in the treated groups than in the check group. Sterilac and sodium hypochlorite groups led with 16 dead germs each. Iodine Suspensoid had 13, chlorinated lime eight, and check which received no treatment had four dead germs.

Chicks dead in shell were also slightly more numerous in the treated group than in the check group. The Sterilac treated group was high with 14 dead in shell. Sodium Hypochlorite was next with 13, Iodine Suspensoid had 11, Chlorinated lime nine, and the untreated check had seven chicks dead in shell.

Crippled chicks were quite equally distributed. The Sterilac group produced five, Sodium hypochlorite, six; Iodine suspensoid, three; chlorinated lime, two; and the check group had five classed as crippled.

Some eggs were accidently broken and some groups suffered more than others in this respect due to the turning devices of the incubator failing to function properly at times. The Sterilac group had two broken eggs, Sodium hypochlorite lost seven eggs in this manner, none were broken in the Iodine Suspensoid group, while the chlorinated lime group had 11 broken. The check group lost three by breakage.

The sub-groups which were sprayed with their respective disinfecting solutions and those sub-groups which were immersed and immediately placed on the tray returned 85 good chicks each for the combined results of these four sub-groups. Those immersed for one minute returned 80 chicks for the four sub-groups in this class, while the eggs which were immersed three minutes returned 74 chicks. The

check or untreated sub-groups returned 94 chicks, which was the highest return for any of the groups.

Conclusions

It is quite probable that very little difference exists among the various commercial disinfectants in regard to a detrimental effect on hatching eggs. Some variation exists in the hatchability and fertility of the various groups in spite of best attempts to distribute this factor as evenly as possible. If any detrimental effect exists in treating eggs with disinfecting solutions, it is quite likely that most of the solutions have about the same effect.

ELECTRICITY GIVES FARMERS A NEW HIRED MAN

Research Work Points Out Profitable Uses in Rural Communities

BY H. J. GALLAGHER, AGRICULTURAL ENGINEERING SECTION

The use of electricity on the farm for purposes other than lighting or operating a few small appliances has received tremendous impetus the past two or three years. The most encouraging phase of this increased use of current is the fact that the per unit energy costs decrease as consumption increases. The cost of delivering electric energy is several times the cost of generating it, and it costs but little more to deliver a lot of current than it does just a small amount. The energy consumption of lights is so low that it has been necessary for the power companies to make a relatively high charge for this service.

There are amazing possibilities in the use of current beyond the lighting load and at a cheaper rate, and the very nice part about using electricity for doing productive work is the fact that, when intelligently used the saving made through decreased costs of operation as compared with other methods will pay or more than pay for all the current used on the farm. In fact, the use of electricity for power is the objective of the country wide movement toward rural electrification.

On a number of farms in Michigan, this objective has been reached, and the "electrical" hired man is helping in the barns, the poultry houses, and in the farm home, and is doing this work more efficiently and at less cost than it was done before.

Some of the uses of electricity that have proved practical on the farm are listed with the average kilowatt hour consumption and service requirements.

On every farm having electric service, at least a few of the uses listed, in addition to lighting, would prove profitable. A farmer who

Some Farm Uses of Electricity and Average Current Consumption*

Operation	Capacity	Load	Kilowatt Hour consumption.
Household uses			
House lighting		100-2000 watts	15-50 KWH monthly.
Washing machine		¼ h. p	2-4 KWH monthly.
Iron		500-600 watts	5-8 KWH monthly.
Ironer		1500-2000 watts	8-12 KWH monthly.
Vacuum cleaner		⅛-¼ h. p	2-4 KWH monthly.
Range		5500-7200 watts	100-150 KWH monthly.
Refrigeration		⅛-⅓ h. p	30-100 KWH monthly.
General farm uses			
Pumping water	200-400 gal. per hr.	¼-½ h. p	10-20 KWH monthly.
Barn lighting		200-1000 watts	5-30 KWH monthly.
Poultry house lighting		120 watts per 100 hens	9 KWH per month per 100 hens.
Incubator	620 egg		172 KWH per hatch.
Brooder	300 chicks	600 watts	45-150 KWH monthly.
Cream separator		¼ h. p	1 KWH per 1000 lbs. milk.
Churning		¼ h. p	2 KWH per 100 lbs. butter.
Grinding (grain)			
Ear corn	500-1500 lbs. per hr	2-5 h. p	10-15 KWH per ton.
Oats or barley	100-850 lbs. per hr	2-5 h. p	20-25 KWH per ton.
Shelled corn	1000-4800 lbs. per hr	2-5 h. p	5-10 KWH per ton.
Silo filling	5-8 tons per hr.	5 h. p	¾-1 KWH per ton.
Corn husking and shredding	2-4 roll husker	5 h. p.	20 KWH per 100 bu. corn.
Shearing		½ h. p	2 KWH per 100 sheep.
Buzz saw		3-5 h. p	1-5 KWH per cord.

*Data Michigan Experimental Electric Line and Committee on the Relation of Electricity to Agriculture, Volume IV, No.1.

uses less than 100 kilowatt hours monthly is generally getting too small a return from his electric service. Some farmers that are using 300 to 500 kilowatt hours monthly find that electricity pays a large dividend on the money invested in wiring and equipment.

The selection of electrical equipment depends largely upon the individual and the farm requirements. The washing machine, electric iron, and water system are usually the first items considered. These are followed by the vacuum cleaner and the electric range; and, for farm work, the cream separator, the small grain mill, and the milking machine lead in popularity and practical application.

The difference which this amount of equipment makes on a farm is hard to realize, but farmers thus equipped fully appreciate the uses of electricity, and they constantly add new chores for the "electrical" hired man who never grumbles and never gets tired.

SAFE METHOD FOR HANDLING THE HERD SIRE

Possible to Keep Animals in Service Longer with Proper Management

BY F. E. FOGLE, AGRICULTURAL ENGINEERING DEPARTMENT

Good sires are necessary to build up and maintain productive herds. The value of a herd sire cannot be determined until the type and production of his daughters is known. Thus, it is desirable to keep any bull until he is mature, and the best bulls should be retained as long as they can be kept in service. Many valuable bulls are prematurely lost for service because the owner does not have a yard in which the bull can be handled easily and safely.

It is a common practice to sell the bull to the butcher as soon as he begins to show his strength and energy by bellowing and pawing. This is only natural for a bull; he may or may not be ugly. Every mature bull should be handled as though he were ugly. By means of proper yarding and equipment, which is within the means of any farmer, any bull can be handled with ease and safety.

Fencing the Bull Yard

The first requisite of a fence for a bull yard is that it be secure. A bull should never be allowed to get through a fence for when he once learns that he can get through, it is more difficult to make a fence that will hold him.

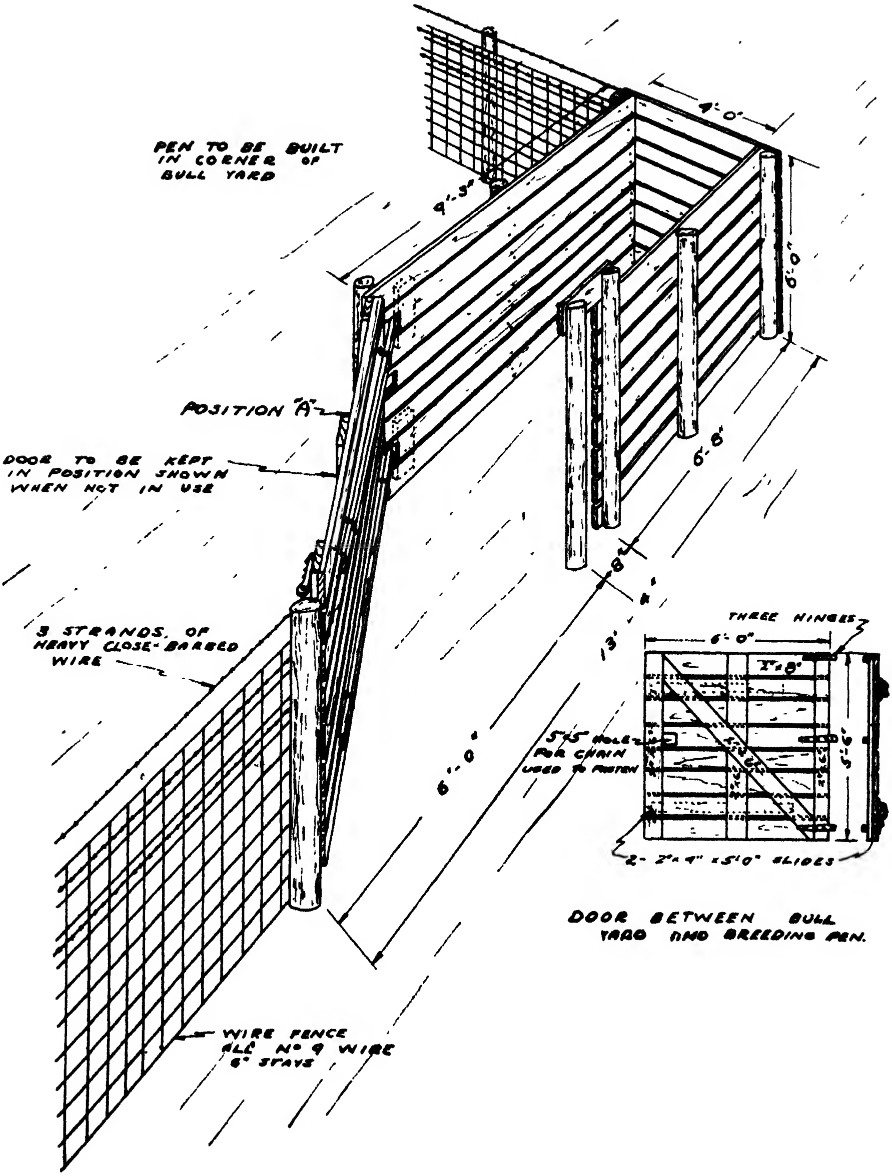
The fence should be so constructed that the bull cannot get his head over, under, or through it.

Hardwood poles, four inches to six inches in diameter, bolted or wired to posts set about eight feet apart are very satisfactory. If poles are not available, two inch by six inch plank may be bolted to the posts.

Woven wire fence with a heavy barbed wire along the top may be used to enclose a larger lot. The fence should be five feet high, have stays six inches apart with both stays and line wires of No. 9 wire.

The yard can also be satisfactorily enclosed with heavy barbed wire. The posts should be set 10 feet to 12 feet apart with seven or eight strands of the heavy four point barbed wire. The barbs should not be more than four inches apart.

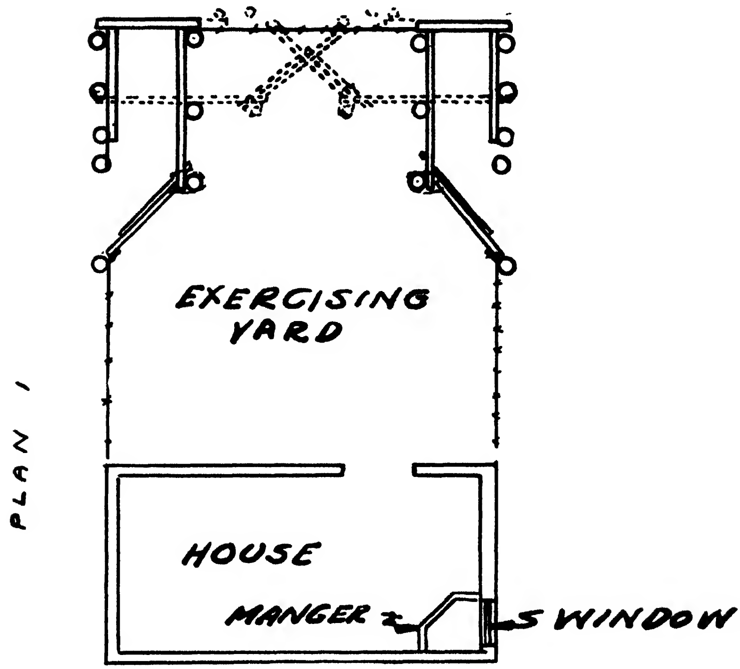
It is desirable that the bull have a view of the outside that he may become accustomed to people as he is less likely to develop an ugly disposition.



A Safety Bull House

The feeding manger should be so located that the bull can be fed and watered from the outside.

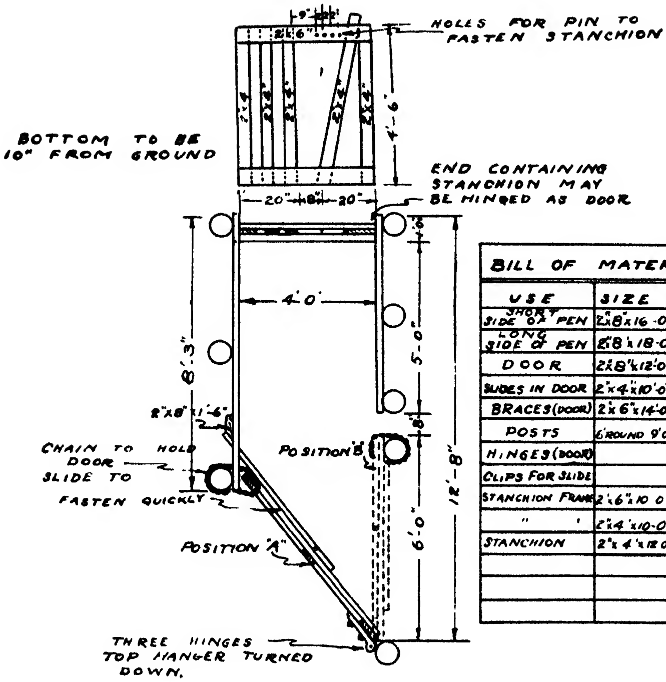
If the bull can be caught readily, he may be secured by the ring while his pen is being cleaned, otherwise a heavy stanchion may be operated by a rope to catch and secure him.



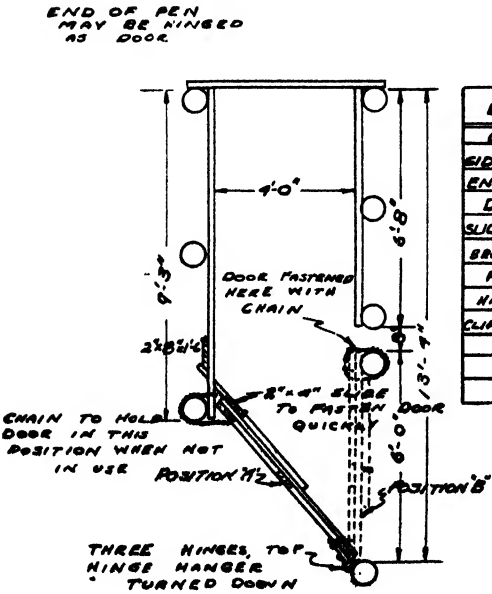
FOUR POSSIBLE LOCATIONS OF PEN IN YARD

Safety Breeding Pen

A breeding pen connected with the exercising yard is a safety device for use in breeding cows if the bull is running loose in the yard. The arrangement is shown in perspective in Figure 1. Figure 2 shows a plan of the pen with bill of material necessary. Figure 3 shows a plan of the pen made shorter to accommodate a stanchion. With the swing gate in position "A" the cow may be led into the breeding pen. The gate is then swung to position "B" to admit the bull. In removing animals from the pen, the bull is first forced back into the exercising yard, and the gate swung back to position "A." The cow may then be backed out. The gate at the front of the pen may be hinged to permit leading cow out. The gate should be kept in position "A" to prevent the bull tramping up the breeding pen. Figure 4 shows an exercising yard next to the bull house with four possible locations for the safety breeding pen indicated.



BILL OF MATERIALS FOR PLAN 2			
USE	SIZE	NO	DESCRIPTION
SHORT SIDE OF PEN	2"x8"x16'-0"	4	
LONG SIDE OF PEN	2"x8"x18'-0"	4	
DOOR	2"x8"x12'-0"	4	
SLIDES IN DOOR	2"x4"x10'-0"	1	
BRACES (DOOR)	2"x6"x14'-0"	2	
POSTS	6" ROUND 9'0"	8	
HINGES (DOOR)		3	
CLIPS FOR SLIDE		4	
STANCHION FRAME	2"x6"x10'0	2	
" "	2"x4"x10'-0	2	
STANCHION	2"x4"x12'0"	1	



BILL OF MATERIALS FOR PLAN 1			
USE	SIZE	NO	DESCRIPTION
SIDES OF PEN	2"x8"x16'0"	8	
END OF PEN	2"x8"x10'0"	4	
DOOR	2"x8"x12'0"	4	
SLIDE IN DOOR	2"x4"x10'0	1	
BRACES (DOOR)	2"x6"x14'0	2	
POSTS	6" round 9'0"	8	
HINGES		3	
CLIPS FOR SLIDE		4	

TESTS SHOW OLD METHODS SATISFACTORY

Black Scurf of Potatoes Is Controlled by Corrosive Sublimate

BY J. E. KOTILA, BOTANICAL SECTION

The following preliminary report on potato seed treatments carried on at the Michigan State College in the summer of 1927 is being presented in response to the demand from potato growers for recommendation upon the new organic mercury compounds which are now being extensively advertised for use in treating potatoes.

For several years, there has been a lively interest in improved methods of treating seed potatoes for the control of various tuber borne diseases. One of the developments along the line of plant disease control has been the introduction of organic mercury compounds for various types of seed treatment, and, now, an attempt is being made to extend the use of these compounds to potato tuber treatments. Some preliminary tests in other states seemed to indicate that favorable results might be expected, but, inasmuch as the range of conditions presented is so great, it is evident that tests over a wide area and over a number of years will be necessary to evaluate these new compounds.

In the new methods, some improvements in carrying out the treatment were suggested. It was recommended that the seed tubers be merely dipped into these solutions while in the standard method they must soak in the mercuric chloride solution for at least one-half hour. Such rapid treatment, if effective in controlling rhizoctonia (black scurf), common scab, and black leg, would be a great advance.

The 1927 tests at Michigan State College were for the purpose of comparing the efficiency of several of these organic mercury compounds, some of which are now on the market, with the standard mercuric chloride treatment to determine whether the new dip treatments can be recommended to replace the former practice.

The potato stock which was used in the tests, here reported, was the Irish Cobbler variety. The tubers were severely affected with rhizoctonia (black scurf), and common scab. They were also found to be affected with blackleg which permitted observations to be made on the control of this disease as well as the others before mentioned.

Experimental Methods

The tubers of one-half of the stock used in this experiment were treated by the various methods before they were cut, while those of the other half were subjected to similar treatments after the seed pieces had been cut. In planting, each treatment was replicated five

times. The field was so arranged that there were six treated plots between the check plots which were of untreated potatoes. There was a total of fifty check plots in the entire experiment.

When planting, it was observed that the seed pieces which were treated after cutting were black and had shrivelled considerably. However, there were no apparent differences in the time of emergence of the sprouts and there were no indications that any one treatment had stimulated or retarded germination of the viable seed pieces. The per cent of stand (see table) appears to show that the hot mercuric chloride and hot formaldehyde caused some injury to the seed pieces. The stands of potatoes in the hot formaldehyde plots were conspicuous because of the number of missing hills. There was no difference in the vigor of the plants of the various plots during the course of the experiment.

Weather Conditions

The season was very dry, and only a very small percentage of blackleg of the seed-borne type appeared in the plots. The percentages which occurred in the various tests are recorded in the table. Owing to the adverse weather conditions no conclusions on blackleg control are justified, as, under more favorable moisture conditions, it would hardly be probable that the untreated check plots would show a smaller amount of the disease than those which were treated.

At harvest, the plots were dug by hand and the counts for disease were made by examining every tuber. There were no significant differences either in the yields obtained or in the control of common scab. The counts on the amount of rhizoctonia which was present showed that differences existed in the efficiency of the various disinfectants in the control of this disease. The results which were obtained in this experiment are given in the following table.

Results of Tests

The results obtained from the 1927 tests indicate that the organic mercury compounds now on the market are more or less efficient in the control of rhizoctonia on potato but that they are not superior to the standard mercuric chloride treatment. It is probable when the active ingredients in the organic mercuric disinfectants is increased, so that it is more nearly equal to the toxicity of mercuric chloride, these compounds may be found equally as effective as the standard treatment. Until additional tests of the organic mercury compounds under different seasonal conditions than those which prevailed in 1927 have been made, the replacement of the standard corrosive sublimate method by these new methods can not be recommended. Former experiments have shown that satisfactory control of rhizoctonia and common scab is obtained by treating seed tubers for thirty minutes in a solution of mercuric chloride used at the rate of four ounces to thirty gallons of water, and, until further work is done, we advise reliance upon the standard treatment.

Table 1.—Effect of the 1927 potato seed treatments on the control of rhizoctonia (black scurf) and blackleg.

Treatment	Time of treatment					
	Before cutting			After cutting		
	Stand per cent	Rhizoc. per cent	Blackleg per cent	Stand per cent	Rhizoc. per cent	Blackleg per cent
Check (not treated)	97 1	33 5±5 39	0 46	97 1	33 5±5 39	0 46
*Semesan Bel 1:10	96 2	21 9±4 04	2 00	96 7	21 2±4 04	0 66
*Semesan Bel 1:20	96 7	19 6±4 31	1 33	97 3	18 7±2 29	2 00
*Semesan Bel 1:30	98 6	22 2±2.23	0 66	97 3	13 9±2 25	4 00
*Semesan Bel Dust	98 0	26 3±1 48	2 00	98 0	12 4±5 05	2 00
No. 12 Bel 1 10	100 0	12 6±3 23	0 00	99 6	6 8±1 14	1 30
No. 12 Bel 1:20	99 3	10 7±2 25	0 00	96 7	10 1±4 47	0 66
No. 12 Bel 1 30	96 7	8 2±2 29	0 66	97 3	6 3±2 29	0 66
No. 12 Bel Dust	94 0	9 3±1 34	2 00	96 0	4 8±1 75	0 00
No. 37 Bel 1 10	92 0	3 9±1 41	0 66	97 3	4 1±1 14	0 66
No. 37 Bel 1 20	96 7	10 4±3 77	2 66	94 0	3 5±2 02	2 66
No. 37 Bel 1.30	96 0	10 7±3 91	1 33	94 0	14 6±2 42	0 00
No. 37 Bel Dust	96 7	14 7±3 17	1 33	98 0	3 6±1 08	0 66
No. 21 Bel 1 15	84 1	12 3±4 18	0 66	92 7	3 5±2 69	0 66
No. 21 Bel 1:20	93 4	21 2±6 9	2 00	95 3	1 9±2 42	1 33
No. 21 Bel 1:30	93 2	17 0±4 85	1 33	96 0	13 5±2 56	0 00
No. 21 Bel Dust	92 7	10 5±2 42	0 66	96 7	13 8±6 61	0 00
*Dipdust 1:20	94 7	14 0±3 97	0 66	98 0	8 5±4 72	0 66
Bayer 181 1:40	95 3	10 7±4 31	0 00	98 0	10 8±5 12	1 33
Mercuric chloride cold	95 3	6 7±3.64	1 33	.	...	.
Mercuric chloride hot	93 4	20 4±6 40	0 00	87 4	10 7±4 38	1 33
Formaldehyde hot	80 2	15 2±3 91	0 00	78 9	17 5±4 18	0 00
Formaldehyde cold	90 7	22 3±4 51	1 33	. .	...	......

*Semesan Bel and Dipdust are organic mercury disinfectants now on the market and are products of the I. E. DuPont Nemours & Company and The Bayer Company, respectively, who furnished these and the other organic mercury compounds (not yet placed on the market) used in these experiments. The tubers and seed pieces were immersed in the treating solution only long enough so that they were covered with the disinfectant after which the solution was poured off and the tubers spread out to dry. The dusts were applied at the rate of two ounces per bushel of uncut tubers or three ounces per bushel of cut seed pieces. The time required in each of these dust treatments was about two minutes. The tubers were rolled in the dust to secure complete covering.

Mercuric chloride was used at the rate of 1 to 1,000 (4 ounces to 30 gallons of water) and in the cold solution the length of treatment was one and one-half hours. In the hot treatment the tubers were immersed for two minutes at 52-50° C. in a solution of similar strength.

Formaldehyde was used at the rate of 1 to 240 (1 pint of formalin to 30 gallons of water) for the cold solution in which the tubers were immersed for one and one-half hours. A 1 to 120 strength was used for the hot treatment. The tubers were subjected to a temperature of from 52-50° C. in this solution for two minutes after which they were covered with wet burlap for one hour.

VARIETIES OF GREENHOUSE TOMATOES TESTED

Several New Strains and Varieties Show Promising Results

BY J. B. EDMOND, HORTICULTURAL SECTION

The forcing of tomatoes is a highly specialized industry. It requires a distinct type of tomato plant for the most satisfactory results. Forcing varieties differ materially in plant characteristics from those adapted for outdoor culture. The plants should be stocky, with short internodes. They should set fruit freely without hand pollination, and should combine productiveness with smooth solid fruits of good form, uniform color and medium size.

A varietal test was conducted in one of the college greenhouses in the spring of 1927. The soil in the house is a very light uniform sandy loam. Immediately before the soil was prepared for planting, sheep manure was applied at the rate of four tons per acre.

The seed was sown in flats January 15 and the seedlings transplanted to other flats February 11. They were transplanted to three inch clay pots March 4 and on March 25 placed in the greenhouse bed 20 inches apart in rows 28 inches apart; one row of 75 feet being given over to each variety. The plants were trained to the single stem system; all the laterals were pruned off when less than two inches long. No hand pollination was practiced.

During the early part of the season, growth was very vigorous. Later, a heavy infection of leaf mold checked growth and reduced yields considerably. This was particularly the case with those varieties occupying the center rows of the greenhouse.

Table 1.—Yields of varieties of tomatoes grown in Station greenhouse, 1927

Variety	Total number fruits	Total weight (lbs.)	Average number fruits per plant	Average weight fruit per plant (lbs.)	Average weight of fruit (oz.)
Grand Rapids (Vaughan)	2675	396 8	66 9	9 9	2 3
Bonny Best Forcing (Stokes Super Standard)	1354	366 0	33 8	9 2	4 3
Grand Rapids Forcing (Grand Rapids Growers' Assoc.)	2541	348.3	63 5	8 7	2.4
Frogmore Select (Vaughan)	2028	346.5	50 7	8 7	2.8
Best of All (Vaughan)	1188	336.7	29.7	8 4	4.5
Grand Rapids Ideal (Grand Rapids Growers' Assoc.)	2005	330.3	50.1	8 3	2.5
John Baer (Mich. Exp. Sta.)	1128	318 3	28 2	8 0	4.4
Bonny Best Forcing (Vaughan)	1401	317 0	35 0	7.9	3.5
Sterling Castle (Vaughan)	2893	317.3	72.3	7.9	1.6
Marglobe Forcing (Stokes Super Standard)	1488	313.3	37.2	7.8	3.3
Nellist Ideal (J. Nellist)	2068	295.8	51.7	7 3	2 2

At harvest, the fruit was carefully graded, all small and inferior tomatoes being rejected and not included in the yield records.

The data in Table 1 show that the Grand Rapids (Vaughan) and the Bonny Best Forcing (Stokes Super Standard) yielded the greatest weight of fruit per plant. Both of these varieties grew rather rapidly, had very short internodes, an abundance of foliage, and set the majority of their blossoms. The association of these characters with yield is not without significance.

Best of All (Vaughan), John Baer (Mich. Exp. Sta.) and Bonny Best Forcing (Stokes Super Standard) produced the largest and heaviest fruits. Forcing the John Baer, a variety adapted to outdoor conditions, failed to materially decrease fruit size.

Though the Sterling Castle (Vaughan), Granc' Rapids (Vaughan), Grand Rapids Forcing (Grand Rapids Growers Assoc.) were very prolific, their fruits were comparatively small.

Table 2.—Total Growth, total number of blossom clusters and total number of blossoms and fruits per cluster, Jan. 15 to May 17, 1927

Variety	(Average of 10 plants)				
	Total height of stem (inches)	Total number of clusters	Blossoms per cluster	No. of clusters fruiting	Fruits per cluster
Grand Rapids Ideal (Grand Rapids Growers' Assoc.)	39.3	5.8	7.6	2.2	7.3
Grand Rapids Forcing (Grand Rapids Growers' Assoc.)	43.8	5.4	10.0	2.4	7.7
Frogmore Select (Vaughan)..	49.9	5.6	8.6	2.6	7.9
Sterling Castle (Vaughan)	54.2	6.8	13.9	2.8	8.1
Napoleon (Vaughan)	65.3	4.2	96.5	1.0	49.2
Nellist (J. Nellist, Grand Rapids).	40.1	5.9	8.6	2.0	6.0
John Baer (Mich. Exp. Sta.)	51.3	7.0	7.1	3.9	5.2
Bonny Best Forcing (Vaughan)	51.0	6.7	8.1	3.0	6.4
Bonny Best Forcing (Stokes Super Standard)	51.3	5.8	8.1	2.1	6.2
Marglobe Forcing (Stokes Super Standard)	'37.0	4.7	8.4	1.4	5.0
Grand Rapids (Vaughan)	54.5	6.3	11.6	3.3	7.5
Best of All (Vaughan)	49.2	6.9	7.3	2.5	6.8

Brief Notes on Individual Varieties

Grand Rapids Ideal (Grand Rapids Growers' Assoc.). Plants were stocky, vigorous with very short internodes. Blossoms set readily. Fruits were roundish and inclined to be small.

Grand Rapids Forcing (Grand Rapids Growers' Assoc.). Plants were vigorous and productive; the internodes were short and the foliage abundant. The blossoms set fairly well. Though the fruits were uniform in size and shape and graded out well, they possessed a green central core and were inclined to ripen unevenly.

Frogmore Select (Vaughan). Plants were vigorous and prolific. The foliage was sparse and the internodes were long. Fruits were smooth, fairly firm and graded out well. They lacked sufficient size to warrant recommendations for planting.

Napoleon (Vaughan). The data in Table 2 show that this variety

made the most rapid growth and set the greatest number of fruits. The foliage was abundant, and the internodes were long. The blossom clusters were large and branching. The blossoms were numerous, ranging from 50 to 300 per cluster, and produced large quantities of pollen. The fruits were small, two-celled, and rough. They were unmarketable on account of small size and roughness.

Sterling Castle (Vaughan). This variety behaved like Napoleon but to a lesser degree. Though it matured fruits in large quantities they were too small to be of any value. Since both of these varieties had relatively long internodes and matured small fruits they cannot be considered desirable for forcing purposes.

John Baer (Mich. Exp. Sta.). The data in Table 1 show that this strain was a moderately fast grower. It had short internodes and the foliage was abundant. The flower clusters were large. The fruit was very solid, of uniform ripening, but somewhat irregular and rough. It can be recommended for trial plantings.

Best of All (Vaughan). This variety was vigorous and productive. The foliage was fairly dense and dark green. The fruit was roundish, large, smooth, solid, and uniform in ripening. It is a very promising sort.

Grand Rapids (Vaughan). The data show that this variety grew rather rapidly. It produced a large number of fruiting clusters in a comparatively short time. The foliage was abundant and dense. The fruits were smooth, solid, of uniform ripening and coloring. They graded out very well. Though the fruits were rather small this variety can be recommended for trial plantings.

Bonny Best Forcing (Stokes Super Standard). The plants were vigorous and productive. The foliage was thrifty and the stems strong. The fruits were large, roundish to oblong, and uniform in color. The figures show this strain yielded a large quantity of marketable fruits. It is a very promising sort.

Bonny Best (Vaughan). The plants were vigorous producing unbranched clusters. Fruits were medium in size, globular, smooth, and ripened uniformly.

Marglobe Forcing (Stokes Super Standard). The plants were very vigorous and stocky. The internodes were short and the foliage dense. Fruits were round, smooth, solid, and medium in size.

Nellist Ideal. The plants were vigorous with short internodes. The foliage was dense. The fruits were smooth, solid, and uniformly colored but rather small in size. The data in Table 2 show that both Marglobe and Nellist are rather slow growing varieties.

Conclusions

This test and observations made in various greenhouses indicate that the adapted strains of Grand Rapids Forcing, Grand Rapids Ideal, and Bonny Best now grown in Michigan greenhouses should constitute the main plantings until supplanted by better varieties. However other varieties and strains possessing desirable characteristics should

receive thorough trial. Based on the results of this experiment Grand Rapids (Vaughan), Best of All (Vaughan), Bonny Best Forcing (Stokes Super Standard) and John Baer (Mich. Exp. Sta.) produced results to warrant trial plantings. Certain other varieties included in this test, namely; Napoleon (Vaughan), Sterling Castle (Vaughan), and Frogmore Select (Vaughan) cannot be recommended.

TEST FOR KEEPING QUALITIES OF MILK MODIFIED

New Method Makes Laboratory Determinations More Convenient

BY E. D. DEVEREUX, BACTERIOLOGICAL SECTION

The colorimetric hydrogen ion method as a means of determining the keeping quality of milk, proposed by Cooledge, (1), has been found to check well with the actual conditions and keeping quality of milk. However, it has met with a criticism which induced the present author to attempt to modify the test.

The Cooledge test is made by adding 0.1 cc. of the milk in question to 10 cc. of a Bromthymol Blue broth and noting the rate of pH change when incubated at 37° C. until a pH of 5.8 is reached or until the tube has been incubated for eight hours.

Formula of Cooledge Broth*

Beef extract	3.	grams
Peptone	10.	grams
Sodium chloride	5.	grams
Dibromthymosulphonephthalein (Bromthymol Blue)	0.020†	grams
Distilled water	1000	cc.

Adjusted to pH = 7
Autoclaved at 15 lbs. for 15 min.

Bromthymol Blue color standards‡ having a pH range of 5.8 to 7.4 (5.8, 6.0, 6.2, ... 7.4) are used for making the readings.

Broth without the indicator is also prepared and used in the compensating blanks. The compensating blanks are inoculated and in-

*This is the formula that has been recommended to the Digestive Ferments Co., Detroit.

†Recently changed from 0.032 to 0.020 grams per liter.

‡The test has been so devised that the color standards and comparators of either the Hynson, Westcott, Dunning Co., (use test tubes with a diameter of 1.8 cm.) or the LaMotte Chemical Products Co. can be employed (use test tubes with a diameter of 1.5 cm.).

cubated in the same manner as the broth tubes containing the indicator. It is necessary to prepare only two compensating blanks for one day's run or any one batch of samples.

When it is desired to make a reading, the tubes and the compensating blanks are removed from the incubator, cooled to 20° C., and placed in the comparator. The top view of the arrangement of the tubes in the comparator when a reading is to be made is given below.

Back

Additional storage space for color standards.	S	W	S	Additional storage space for color standards.
	C. B.	U	C. B.	

Front

S. = Color Standard
W. = Water Blank
C. B. = Compensating Blank
U. = Unknown containing the milk in question.

The unknown is compared with the color standards and the pH noted.

Cooledge devised a table in order that the milk could be scored, its keeping quality determined, and the purpose for which it is best suited determined. (See Table I.)

Since milk is such an excellent medium for bacterial growth and since gross changes soon develop, it is necessary to start the test as soon as

Table 1

Reading	PH	Score	Milk suited for
1 hour	5 8	20	Condemning.
2 hours	5 8	25	Condemning.
3 hours	5 8	30	Condemning.
4 hours	5 8	35	Skimming for butter making.
5 hours	5 8	40	Skimming for butter making.
6 hours	5 8	45	Skimming for butter making.
7 hours	5 8	50	Skimming for butter making.
8 hours	5 8	55	Skimming for butter making.
8 hours	5 9	60	Condensing.
8 hours	6 0	65	Condensing.
8 hours	6.1	70	Condensing.
8 hours	6 2	75	Condensing.
8 hours	6 3	80	Milk plant supply or cheese making.
8 hours	6 4	85	Milk plant supply or cheese making.
8 hours	6 5	90	Milk plant supply or cheese making.
8 hours	6.6	95	Milk plant supply or cheese making.
8 hours	6 7	100	Milk plant supply or cheese making

the samples arrive at the laboratory. Some of the samples will require the full eight hours before a final reading can be made. This means that the individual performing the tests must find it possible to be in the laboratory eight hours from the time the tests were started. This is often inconvenient if not impossible. Samples arriving at the laboratory late in the morning or in the afternoon will require readings to be made in the evening. An attempt has been made to modify the test to avoid this inconvenience.

Experimental

Several preliminary experiments were carried on in an effort to shorten the incubation period by starting with a larger inoculation of milk. In doing so the opacity of the milk was increased to the extent that the comparison of the tubes with the color standards became very inaccurate. In addition to the opacity, the amount of time cut from the original incubation period was too small to warrant further investigation.

Attempts were made to enrich the broth, but the results did not prove worthwhile.

Finally it was decided to try interrupting the test and finishing the incubation the next day. Preliminary experiments along this line gave favorable results and a definite course of experimentation was planned.

One set of 100 samples was examined in duplicate. One set of the duplicate tests was carried on according to the test as originally devised by Cooledge (i. e., incubation without interruption until a pH of 5.8 was reached or until incubation was carried on for 8 hours). The other set of the duplicate tests was warmed to 37° C. as soon as inoculated, then placed in the 37° C. incubator for seven hours. The tubes were then removed, chilled in cold water, and immediately placed in the ice box at about 3 to 5° C. The next day (20 to 24 hours later) the tubes were removed from the ice box, warmed to 37° C. in warm water and incubated the remaining one hour. Readings were then made. These readings were compared to the set of readings obtained from the tubes which were incubated eight hours without interruption. This constituted what was called the 7 and 1 group (7 hours incubation one day and 1 hour the next). In the same manner data were collected on group 6 and 2, 5 and 3, 4 and 4, 3 and 5, 2 and 6, 1 and 7, and 0 and 8. In group 0 and 8, the tubes were placed in the ice box immediately following inoculation and incubated 8 hours the second day. In each group, as with the 7 and 1 group, a duplicate set of tubes for comparison was inoculated and incubated for 8 hours on the first day of the test. (See Table 2.)

In addition to the above set of experiments, another group of 100 samples of milk was examined by the original test as soon as they reached the laboratory, and the remainder of each sample was placed in the ice box and scored again 20 to 24 hours later. This was done to determine the effect of storage on the score and also to collect data which could be compared with the other data. The results of this group are found in Table No. 3.

Approximately 1,000 samples of milk were examined during the four

seasons of the year; as a result, data from all grades of milk are included in the findings.

Since the color standards used differed from each other by 0.2 pH, it was often difficult to read closer than 0.1 pH. This could be called the limit of error in making readings. Also any error of 0.1 pH changed the score only five points, which as a rule, was not of practical significance. (Occasionally there was more than five points difference but in many of these cases it was again of no practical significance). These scores were, however, recorded separately as will be seen in examining the tables. The ideal condition would be one which would yield, following the interruption, scores which were 100 per cent the same or not more than five points above or below the control scores (scores obtained from tubes incubated eight hours without interruption). By examining the tables the relative efficiencies of the various groups can be obtained.

Table 2

Groups	7 and 1	6 and 2	5 and 3	4 and 4	3 and 5	2 and 6	1 and 7	0 and 8
No. of samples examined	100	100	100	100	100	100	100	100
No. of samples scoring the same as the controls after the test was interrupted	62	82	80	71	74	73	57	71
No. of samples whose scores were different after the test was interrupted but of no significant difference	25	16	18	25	24	14	27	23
Total	87	98	98	96	98	87	84	94
No. of samples whose scores were of significant difference after the test was interrupted	13	2	2	4	2	13	16	6

Table 3

Group	Samples held in ice-box 20-24 hrs.
No. of samples examined	100
No. of samples scoring the same after refrigeration	58
No. of samples whose scores were different after refrigeration but of no significant difference	27
Total	93
No. of samples whose scores were of significant difference following refrigeration	7

Discussion

On examining the data it will be noticed that the results with groups 6 and 2, 5 and 3, 4 and 4, and 3 and 5 are the most efficient. The 0 and 8 group and the refrigerated samples also gave very good results; results which checked well with the control tubes. A practical application of these optional modifications can be made in the following manner. Samples arriving at the laboratory too late to be examined after 8 hours of incubation (if 8 hours were required before a pH of 5.8 was reached), could be incubated 6, 5, 4, 3, or 0 hours. (Or the sample might be refrigerated) and the incubation (or inoculation and incubation of refrigerated sample) completed the second day. There seems to be no practical difference as to wheth r the milk is stored in the broth for 24 hours or whether the milk sample is stored. Because of the high correlations of groups 6 and 2, 5 and 3, 4 and 4, 3 and 5, and 0 and 8, (or refrigeration of the entire sample) with the test as originally devised, the laboratory technician is given a wide range of procedures from which he can select the one which best fits his needs.

Conclusions

1. It was found possible to interrupt the Cooledge test by icing the milk inoculated tubes, and obtain results comparable to those obtained by the test when operated as originally devised.
2. In interrupting the test by icing the milk inoculated tubes, the most efficient results were obtained when the interruption came after 6, 5, 4, or 3 hours of incubation, the tubes being incubated the remaining hours the next day.
3. The efficiencies of the above modifications varied from 96 to 98 per cent.
4. Icing the milk inoculated tubes immediately following inoculation or icing the milk samples for 20-24 hours gave results which checked with the control tubes in 93 to 94 per cent of the cases.
5. The modified method, therefore, when applied in the laboratory helps to meet the "time factor" criticism of the Cooledge test.

References

1. Cooledge, L. H. and Wyant, R. W. The keeping quality of milk as judged by the colorimetric hydrogen ion determination. Jour. Dairy Sci. 3(1920) 156-166.
   Cooledge, L. H. The colorimetric hydrogen determination as a means of studying biological changes in dairy products. Mich. Agr. Exp. Sta., Tech. Bul. No. 52, Nov. 1921.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

251 Insects of 1907.
258 Insects of Field Crops.
262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
273 Utilization of Muck Lands.
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

58 Foul Brood.
65 Hog Cholera and Preventive Treatment.
71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
74 Analysis of Some Materials Sold as Insecticides and Fungicides.
76 Transferring Bees.
79 Michigan's Shifting Sands; Their Control and Better Utilization.
80 Yellow Rocket (a dangerous weed).
82 Durability of Concrete Drain Tile No. 11.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
99 The Detroit Commission Plan of City Milk Administration.
100 Soy Beans.
101 Oats in Michigan.
103 Forest Planting in Michigan.
104 Soils of Detroit Area.
105 Rosen Rye.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
109 Dependable Michigan Crop Varieties.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
116 The Agriculture of the Upper Peninsula of Michigan.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.

120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
122 Improvement of the Farm Woodlot.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
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145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
148 Some Important Grape Insects.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
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153 Peppermint Growing in Michigan.
154 Hardy Shrubs for Landscape Planting in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it upon the receipt of ten cents (coin or stamps).

166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
168 The Management of Michigan Muck Soils for Onion Production.
169 Profit and Loss in Pruning Mature Apple Trees.
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85 Honey Vinegar.
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***Bulletins listed in bold faced type are recent publications of this Station.**

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88 Fertilizer Suggestions for Calhoun County.
89 Culture Greenhouse Lettuce.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
92 Garden Flowers.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
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Vol. XI, No. 1, August, 1928

HAY IS NECESSARY IN RATION FOR DAIRY CATTLE

Unknown Factor Present in Hay Needed to Maintain Health of Dairy Cattle

BY C. F. HUFFMAN, DAIRY SECTION

Hay, especially the legumes cut at the proper stage of maturity and cured so as to retain the leaves and green color, makes the best sole ration for dairy cattle other than pasture. Cattle have been grown on a ration of hay and salt from a few months of age to maturity. E. V. Davenport more than 30 years ago, while connected with the Michigan Agricultural Experiment Station, attempted to raise calves on grain alone without success. Later, while at the University of Illinois, Davenport showed that calves could not be grown from birth to maturity on milk alone or on milk and grain. The addition of hay to such rations brought about recovery. He concluded that coarse food was necessary for the proper physiological functioning of ruminants.

McCandlish of the Iowa Agricultural Experiment Station was also unable to raise calves to maturity on milk alone or milk and grain. The addition of tomatoes as a source of vitamins to such rations failed to prevent death. However, normal animals were produced by supplementing concentrate rations with alfalfa hay. Similar results were obtained at the University of Minnesota. The addition of yeast, as a source of vitamin B, orange juice to furnish vitamin C, or cod liver oil as a source of vitamins A and D failed to furnish the factors carried by hay which are so essential for the health of cattle.

The dairy department at Michigan State College in cooperation with the Experiment Station chemistry section and department of animal pathology are investigating the effects of heavy concentrate feeding and are attempting to discover the factor or factors carried by hay which are so essential to the health of cattle. The results show that concentrate rations adequate for rats and swine are not sufficiently complete to meet the needs of cattle from birth to maturity. Calves fed on such rations usually die in convulsions. (See Fig. 3.)

Coarse feeds in the form of corn cobs, oat hulls, and shavings when added to concentrate rations have failed to prevent the onset of convulsions. Apparently, hay furnishes some factor other than bulk which is essential in the ration of cattle.

Different supplements have been added to concentrate rations. The addition of calcium carbonate, bone meal, or magnesium phosphate delayed but did not prevent the onset of convulsions in calves. Cal-

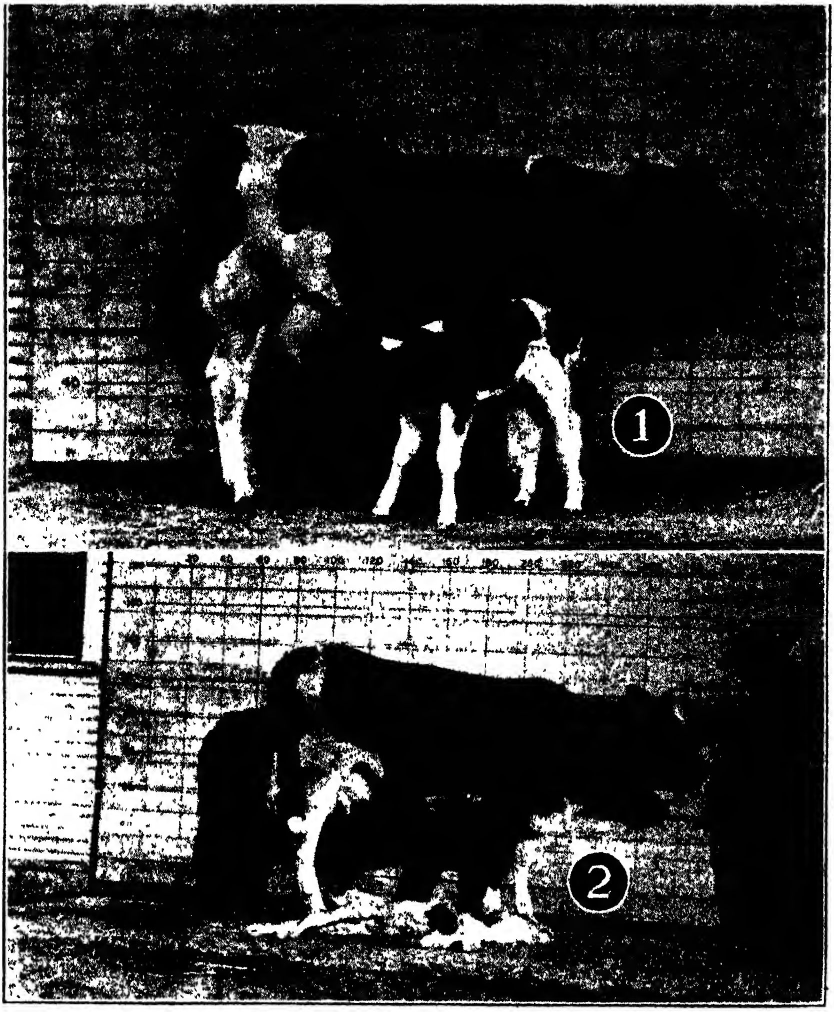

Fig. 1.—This cow was fed a ration of timothy hay, silage, and grain.
Fig. 2.—This cow was fed the same ration as the cow in Fig. 1, except wheat straw replaced timothy hay.

cium and phosphorus metabolism of calves fed such rations is being investigated at the present time. The blood of animals fed on concentrates is also being analyzed for calcium, phosphorus, and alkaline reserve by the chemistry section of the Experiment Station. The symptoms produced in calves which are fed rations without hay are similar if not identical with those in animals suffering from parathyroid deficiency. This relationship is being studied. There is a possibility that hay carries some factor that regulates or assists in the functioning of the parathyroid glands.

The possibility of intestinal stasis is also being studied. Concentrate

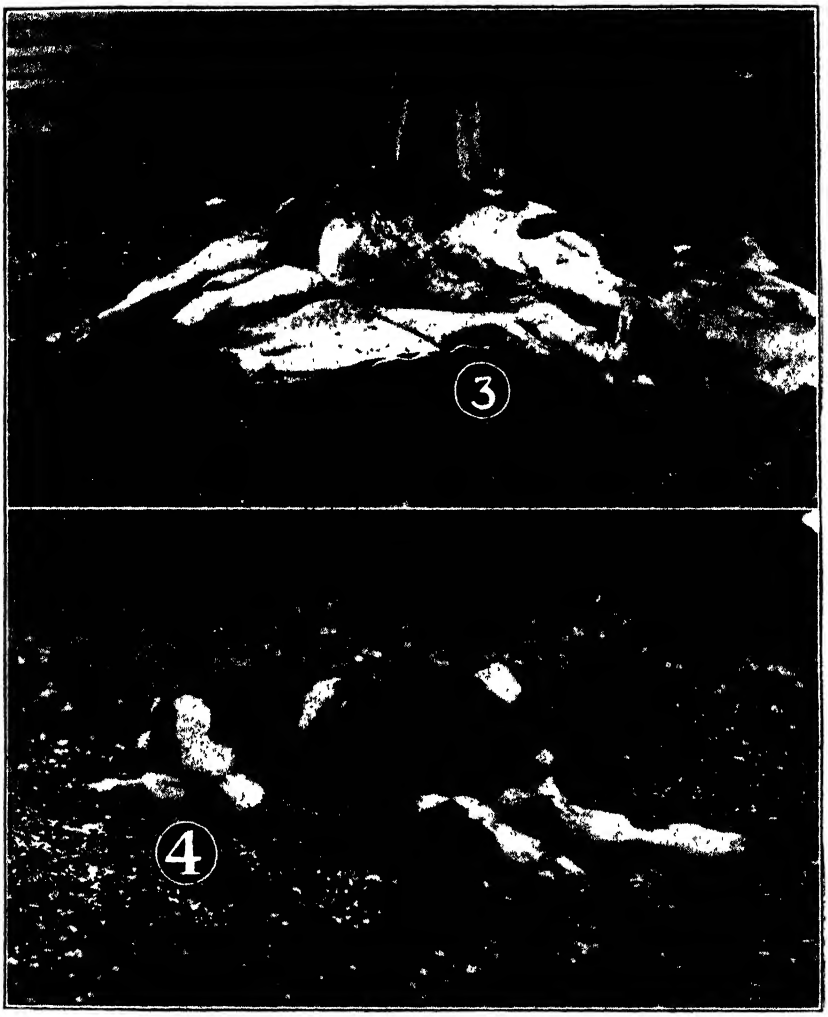

Fig. 3.—Calf in a convulsion, resulting from feeding a ration without hay.
Fig. 4.—The dam of this calf received straw in place of timothy hay. The calf was blind and unable to use its legs.

rations supplemented with neutral paraffin oil, raw linseed oil, and flowers of sulphur have failed to prevent the onset of convulsions.

Cattle fed hay or grass and little or no concentrates produce an alkaline urine. However, when concentrates alone are fed the urine is acid. The possibility of an acid-base disturbance is being investigated, by feeding calves concentrates supplemented with sufficient bases to produce an alkaline urine.

Iron compounds have been fed as supplements to concentrates. C 27 was raised to 500 days of age on whole milk and 20 cc. of syrup of iron phosphate per day. This animal was normal in every respect until

taken off of the experiment. Another calf, C 58, fed whole milk and syrup of iron phosphate, was 109 per cent normal in weight at 405 days of age. However, death occurred in a convulsion at 413 days of age. This animal received only 15 cc. of syrup of iron phosphate daily. Other calves fed concentrates and syrup of iron phosphate have failed to manifest convulsions. Two grams of ferric phosphate added daily to concentrate rations, however, failed to prevent convulsions.

Effect of Feeding Wheat Straw in Place of Hay

The addition of wheat straw ad libitum to a grain mixture containing adequate protein, failed to bring about normal reproduction when fed to dairy cattle. Calves produced by cows fed this ration were born blind and paralyzed.

In a long time mineral feeding experiment, a ration consisting of grain, silage, and timothy hay has met the requirements of dairy cattle for growth, reproduction, and milk production. (See Fig. 1.) In order to determine the value of hay in such a ration, four Holstein heifers were fed the same ration except wheat straw was fed in place of timothy hay. The calcium content of the timothy hay and wheat straw was similar. The ration containing wheat straw in place of timothy hay produced normal growth. The animals appear normal. The estrus cycle was not disturbed, nevertheless, the effect on the strength and health of the offspring was marked. (See Figures 2 and 4.)

Animal C 35 gave birth to two calves which manifested convulsions and were blind. However, the fetal membranes were expelled normally after both calvings. Heifer C 38 gave birth to a blind calf which also had convulsions. This cow retained the fetal membranes, which was responsible for complications which resulted in death seven days following the birth of the calf. C 46 gave birth to a blind calf which appeared paralyzed. She expelled the fetal membranes normally.

C 50 gave birth to a dead calf at two years of age and retained the fetal membranes. However, her second calf was normal. During the second gestation, C 50 consumed more wheat straw than during the first gestation and more than any of the other animals on this experiment. The palatability of the straw may be an important factor. C 35, C 38, and C 46 never consumed more than seven pounds of wheat straw a day, while C 50 during the second gestation consumed 10 pounds daily. No difficulty was experienced in getting cows to eat sufficient timothy hay.

The results of these investigations indicate that the quality and quantity of hay fed to dairy cattle are important factors in maintaining health and reproduction.

CHERRY TREES DEFOLIATED BY LEAF SPOT

Future Fruit Crops Threatened by Failure of Trees to Store Food

BY F. C. BRADFORD, HORTICULTURAL SECTION.

The virulence of the leaf-spot epidemic which is ravaging Michigan sour cherry orchards in the summer of 1928 is bound to present problems to many growers in succeeding years. Though most trees have completed the more readily recognized phase of growth, increase in length, by the time of defoliation, the increase in diameter is only well under way and accumulation of elaborated foods for next year's growth and crop has hardly more than begun. Since this material is elaborated in the leaves, defoliation in midsummer prevents this preparation for the succeeding year and trees defoliated in 1928 are likely to be more or less unfruitful and weak in 1929.

More serious than this, however, is the danger from winter injury. Defoliation in midsummer is a quite different matter from the normal dropping of leaves in autumn and trees whose foliage is stripped prematurely have unripened twigs and branches. Consequently, they are not prepared to withstand winter freezing. Thousands of sour cherry trees have been killed outright in a winter that followed a leaf-spot epidemic. Many more thousands would have helped their owners by dying outright; these received the "black-heart" type of injury, which permitted them to drag along for several years, becoming weaker and weaker, and finally dying by inches.

Black-heart may, however, be outgrown. It affects the wood, leaving the bark unaffected. Since most of the food storage is in the wood, the injury locks these supplies permanently within the wood, and the tree must build up a new supply. Recovery, then, depends on early and abundant development of foliage in the following spring. Pruning should be confined to the removal of dead branches. Nitrogen-carrying fertilizers, sulphate of ammonia or nitrate of soda, should be used rather freely. Light pruning and heavy fertilization favor foliage development and may be used to bring trees into condition for the crop of 1930.

One other complication from black-heart should be mentioned. When pruning wounds expose injured tissue, invasion by wood-rotting fungi is more likely. For a number of years, therefore, it will be advisable to paint pruning wounds in trees which have been injured.

REPORT EXPERIMENTS IN FINISHING BABY BEEF

Test Food Values of Corn, Barley, and Protein Supplements

BY G. A. BRANAMAN AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

Five experiments in fattening baby beef calves for market have been completed at the Michigan Experiment Station. The Station Quarterly Bulletin for August of each year gives the report of the previous winter feeding trials.

The calves fed during the winter of 1927-28 were purchased through the Michigan Livestock Exchange and the National Producers Commission Association Feeders' Calf Pool. They were high grade Hereford calves raised on the Kokernut Ranch, Alpine, Texas. Thirty-four head, half heifers and half steers, were taken from a load of fifty calves. They arrived at the College November 15 after spending eight days on the road. Their weight when taken off the cars showed a shrink of 37 pounds per head as compared with the Texas weight. When started on feed three days later, 22 pounds of the shrink had been recovered. All the calves were in a healthy condition and started on feed without any delay. The tuberculin test showed no reactors.

The calves were divided into three lots, five steers and five heifers in each lot, and as nearly equal as possible according to type, quality, condition, age, and weight. Individual weights were taken for three successive days at the beginning and at the close of the trial, and every ten days during the rest of the feeding period.

Cost of Calves

The heifer calves cost $8.50 and the steer calves $9.50 per cwt. at the Texas loading point. The additional cost in the feed lots on November 18, including freight, feed, shrinkage, and all incidental expenses until started on feed, was $1.75 per cwt.

Objects of Experiment

The experimental work was conducted to compare:

1. Ground barley versus shelled corn when fed with corn silage and alfalfa hay.
2. Linseed meal versus alfalfa hay as the source of protein.

Rations Fed

Lot 1. Ground barley—corn silage—alfalfa hay.
Lot 2. Shelled corn—linseed meal—corn silage—alfalfa hay.
Lot 3. Shelled corn—corn silage—alfalfa hay.

The calves in each lot received all the silage they would clean up readily twice daily, and alfalfa hay was kept before them in racks. A mixture of equal parts bone meal and salt was kept before them in boxes.

A mixture of equal parts by weight of whole oats and ground barley (or shelled corn) was fed the first 60 days, three parts barley (or corn) and one part oats the next 30 days, and barley (or corn) alone the last 115 days. About six pounds of grain per calf per day was fed during the first 60 days, seven pounds the next 60 days, 8.5 pounds the next 30 days and 9.5 pounds the last 55 days.

As compared with Lot 3, one pound of grain in lot 2 was replaced by a pound of linseed meal during the first 120 days, 1¼ pounds the next 50 days and two pounds the last 35 days.

Lot 1 and lot 3 would not take a larger amount of grain later in the period. However, lot 2 seemed eager for more and their ration was increased up to 12 pounds of corn in addition to the two pounds of linseed meal during the last month. Extreme care was necessary to keep lot 1 and lot 3 from going off feed.

Calves Waste But Little Feed

There was not enough grain in the droppings to warrant putting pigs behind the calves until January 12. At that time, two 45 pound pigs were placed in each lot and fed some extra shelled corn and tankage. The pigs in the barley lot were apparently getting very little of the ground barley. There was hardly enough feed in either of the other lots to full-feed one pig. Table 1 shows a summary of the results obtained.

Linseed Meal Increased the Profits

The linseed meal fed to lot 2 in addition to the ration of shelled corn, corn silage, and alfalfa hay received by lot 3, increased the average daily gain 0.22 pounds and increased the selling value 50 cents per hundredweight. The returns per calf above feed cost were thus increased $3.69 and the returns per bushel of shelled corn were increased 24 cents. The return per bushel of shelled corn fed was obtained by charging the other feeds as in the table and crediting all other returns to the shelled corn fed.

Two of the important things in determining the profits in cattle feeding are: the feed cost per hundredweight of gain and the selling value of the cattle, or the margin between the cost price and the selling price. While the calves in lot 2 made somewhat faster gains than those in lot 3, the cost of gains was also increased somewhat. A trifle more pork was also produced in lot 3, which helped to lower the cost of gains. However, the calves in lot 2 were enough better finished than those in lot 3 to increase the selling value 50 cents per hundredweight. This increase in value paid the extra feed cost and left an additional profit.

Barley versus Corn

The calves in lot 1 which were fed the ground barley made practically the same gain as those fed the shelled corn in lot 3. They were slightly

Summary of Results

10 calves per lot
2 pigs per lot

Nov. 18, 1927—June 10, 1928
205 days

Grain rations	Lot 1 Gr. barley lbs.	Lot 2 Sh. corn Linseed meal lbs.	Lot 3 Sh. corn lbs.
Initial weight per calf	364	361.9	361.5
Final weight per calf	768 4	802.7	757.0
Total gain per calf	404.4	440.8	395.5
Average daily gain	1.97	2.15	1.93
Average daily ration:			
Ground barley	6.30	....	....
Shelled corn	....	5.90	6.30
Whole oats	1.07	.90	1 07
Linseed meal	....	1.25	....
Corn silage	11 20	15.01	11.00
Alfalfa hay	4 45	3.27	4.60
Feed per cwt. gain:			
Ground barley	319 5	....	....
Shelled corn	....	274 2	326.7
Whole oats	54.3	41.9	55 5
Linseed meal	....	58.4	....
Corn silage	568 0	698.2	570.4
Alfalfa hay	225 4	151.9	238.6
Feed cost per cwt. gain	$9 31	$9.79	$9.55
Pork credit per calf (lbs.)	17 07	15.88	24 14
Pork credit per calf (@ $9 25 per cwt.)	$1.58	$1.47	$2 23
Feed cost per cwt. gain (crediting pork)	8 92	9 46	8 98
Initial cost in lots per cwt	$10.75	$10.75	$10.75
Initial cost in lots per calf	39.13	38.90	38 86
Feed cost per calf	37 66	43.17	37 75
Cost of calf plus feed cost	76 79	82.07	76.61
Necessary selling price in lots to break even (crediting pork)	9 79	10 04	9 83
Selling price in lots (Detroit price less 85 cents)	13.15	13.40	12.90
Selling price per head in lots	101.05	107.56	97.65
Returns per head above feed costs			
Omitting pork	24.25	25.49	21.04
Crediting pork	25.83	26 96	23 27
Return per bu. gr. barley or shell corn	1.80	2 23	1.99
Return per cwt. gr. barley or sh. corn	3 75	3.98	3.55

Prices of feeds:
Ground barley 84 cents per bu., shelled corn 98 cents per bu., oats 56 cents per bu., linseed meal $55 per ton, silage $5.00 per ton, alfalfa $12.00 per ton, tankage $3.75 per cwt., pork credited at $9.25 per cwt.
The selling price at the close of the experiment was estimated by representatives of the Detroit market on the basis of market conditions at that time.

better finished, however, and were valued 25 cents per hundredweight higher than the corn-fed calves, returning $2.56 more per calf above feed cost. A similar return in favor of the calves which were fed corn was shown last year. In both trials, the rate of gain and the feed consumption has been practically the same in each lot, the difference has been entirely a matter of finish, or selling value. Further data will be necessary on these two feeds before we will be able to draw positive conclusions.

It should also be noticed that the prices charged for ground barley and shelled corn have been the same per pound, no charge has been made for grinding the barley.

Calf Feeding Profitable

The results shown in table 1 leave a nice profit above feed costs in spite of the high price for feed during the past winter. A large margin between cost price and selling price is not necessary to show a profit with these young calves when a good ration is fed. They require con-

siderably less feed to produce 100 pounds of gain in weight than do older cattle.

YEASTS CAUSE THE FERMENTATION OF HONEY*

Reduction of Moisture Content Improves Keeping Qualities

F. W. FABIAN, BACTERIOLOGICAL SECTION

The spoiling of any finished product which is ready to market always represents a loss. Honey is no exception to this rule. At one time many farmers kept a few colonies of bees to produce honey for their own consumption and very little of it was sold. Most of the honey was consumed in the comb and little was extracted. If spoilage did occur, the loss was small and little attention was paid to it. However, due chiefly to bee diseases, this condition has gradually changed until today the bulk of the honey is produced in large apiaries. Likewise most of the honey is extracted and often is stored for a period of time to await a favorable market or is gradually released to avoid flooding the market. When honey is stored in large quantities, fermentation is more noticeable than if the same quantity was stored in many places in smaller quantities, and often causes a considerable economic loss.

The bacteriological section of the Experiment Station has been making a study of the cause of fermented honey for the past several years and has reached some definite conclusions regarding the cause and also has developed some preventive measures.

What Causes Honey to Spoil

A great many samples of honey have been submitted for analysis from many parts of Canada and the United States. Bacteriological analyses were made, and molds, yeasts, and bacteria were isolated from practically every sample. These organisms were then planted in concentrated sterile honey. It was found that the bacteria would ferment solutions containing as high as 10 per cent of honey but were unable to grow in solutions beyond this concentration. Yeasts were the only group of microorganisms that were capable of fermenting concentrated honey.

Twenty-five different yeasts were isolated and placed in five groups. Four out of five of these groups were classified as *Zygosaccharomyces*

*Tech. Bul. 92 in which the detailed scientific data are available may be obtained by those who are especially interested.

and one as *Torula*. These are the scientific names used by the bacteriologist for certain groups of yeasts.

Relationship Between Moisture and Fermentation

The various samples of honey were also analyzed for moisture content. It was found that there was considerable variation in the water content but, on the whole, the fermented honey had a higher water content than the unfermented. It was concluded from this relationship that 21 per cent of moisture was the critical point above which fermentation was likely to occur although two samples showed spoilage with as low as 17 per cent water while some with a slightly greater percentage of moisture had not fermented when received but did in most cases if they were held for some time.

Experiments were also carried out to ascertain whether honey absorbed water or not. It was found that in a humid or moist atmosphere it absorbed as much as 33 per cent water. Sterile samples of honey were seeded with the yeasts and placed in a moist atmosphere and it was found that fermentation took place as soon as they had absorbed more than 21 per cent of moisture. This led to the conclusion that honey should be kept in a cool dry place.

Comb honey was placed in a very dry atmosphere for a period of seven years and during that time it lost 7.5 per cent moisture. Comb honey was also placed in a moist atmosphere and it absorbed, at the most, slightly more than five per cent. From these experiments, it was concluded that comb honey gives up moisture slowly and likewise absorbs moisture slowly.

How to Prevent Honey From Spoiling

Experiments were carried out to test the degree of heat which was necessary to kill these yeasts. It was found that a temperature of 145° F. for 30 minutes killed all of them. It is, therefore, advisable to heat honey as indicated above, if there is any question whether it will keep or not. This procedure is especially recommended for unripe honey. It is a common observation among bee-men that improperly cured or unripe honey usually spoils unless used soon after harvesting or unless the excess moisture is reduced. One of the best ways to do this is to evaporate the moisture by heating under reduced pressure as in a vacuum pan. After the excess moisture has been reduced, it should be heated then to a temperature of 145° F. and kept at this temperature for 30 minutes to insure its keeping properties.

Conclusions

The information which has been gained from this series of experiments may be briefly summed up by saying that a minute microscopic plant called a yeast has been isolated from fermented honey. These same yeasts when planted in sterile honey were capable of causing fermentation. Honey absorbs moisture from the atmosphere. When sufficient moisture has been absorbed fermentation will take place if the proper yeasts are present. Honey should, therefore, be stored in a cool dry place. Unripe honey has a tendency to spoil. The excess

moisture should be reduced by evaporation. The yeasts causing fermentation in honey are killed by heating to a temperature of 145° F. for 30 minutes.

FUNGOUS DISEASES ATTACK TREES IN WET SEASONS

Damage Done Rarely Causes Death of Shade Trees

BY FORREST C. STRONG, BOTANICAL SECTION

The past spring and early summer months have been very favorable for the growth of the various fungi which attack the leaves of our deciduous trees and cause the many leaf diseases. The continued wet, cool weather has been almost ideal for the growth and development of the fruiting stages of these fungi, which have lived over winter on the dead leaves, causing the infection of this year's leaves. Many of the leaf disease fungi attack the veins of the leaves, stopping the passage of water into the leaf tissue beyond the place infected, and as a result, fan shaped, brown areas are formed. In some cases the brown, reddish to yellow spots resulting from the attack of these various organisms may be scattered promiscuously about on the leaf surfaces.

Anthracnose of Sycamore and White Oak

This leaf disease has been very common on sycamore and the white oaks. In some cases, the sycamores have been defoliated. This disease is characterized by the appearance of brownish, dead areas along the veins. Later, minute, brown dots appear on the veins in the dead areas. These are the fruiting bodies (acervuli) of the causal organism. The spores, which act as seeds of the fungus, are produced in these fruiting bodies and are splashed by rain to healthy leaves, thus causing the spread of the disease. Severe infections lead to the wilting of the leaves and defoliation of the tree. Sycamore anthracnose is more serious than the other leaf diseases because the smaller twigs are also infected. This stops the passage of water into the twigs, and many of these die. In oak anthracnose, infection may take place on other parts of the leaf than on the veins so that spots of varying size are found over the entire surface. Ordinarily, white oak leaves are found with dried, blighted tips and with large spots scattered on the surface. The affected tree is unsightly and appears blighted.

The control measures advocated for the anthracnose disease of trees are the raking and burning of the leaves in the fall, so that the diseased leaves upon which the fungus lives over winter will be destroyed. Trimming out of infected twigs, which may be recognized by the long, narrow, split-bark appearance of the canker, would be very beneficial but is a tremendous task if many trees are involved. Spraying with Bor-

deaux mixture can be resorted to if the disease appears persistently year after year. Spray first just after the leaves have burst their buds, then once every two weeks, depending on the weather conditions. These definite preventive measures find their applicability with young trees.

Tar Spot of Maple

This disease may readily be recognized by the appearance of large, black- tar-like spots on the leaves of red and silver maples. This leaf spot very seldom does damage. The burning of all infected leaves in the fall will usually control the disease.

Figure 1.
A. Anthracnose of sycamore.
B. Anthracnose of white oak.

Elm Leaf Spot

This disease becomes very prevalent in late summer on American and other elms, if the season is wet. This leaf spot disease is characterized by the appearance of grayish spots where the leaf tissue has been killed by the infecting fungus. Later, in these same grayish areas, there appear tiny, black spots which may increase in number and fuse to form larger black spots so that a considerable area of the leaf appears black with a gray to yellowish margin. If the weather is favorable, this disease may become so severe as to cause extensive defoliation. Usually however, the disease appears so late in the fall that little damage is done. Raking and burning of the fallen leaves will help prevent overwintering of the causal organism.

Powdery Mildews and Sooty Molds

In wet seasons, the powdery mildews become abundant. The affected leaves are covered with powdery, white patches on both upper and lower surfaces. In cases of severe attack, the leaves shrivel and dry. As a rule, they cause little damage to the leaves and can be ignored on mature trees. Powdery mildew on young trees and shrubs can be readily prevented by a lime-sulphur spray or a sulphur dust.

The sooty molds are saprophytic fungi which live on the "honey dew" excreted by aphids. In severe cases, the sooty molds will cover the leaf surfaces with a layer of sooty appearing material. This gives the trees a very unsightly appearance, although little harm is done to the tree. If the aphids are killed by proper spraying, the sooty mold organisms will disappear.

Leaf Blotch of Horsechestnut

This disease develops early in the season and becomes quite common later in the summer. The symptoms of the disease are the reddish brown patches which appear on the leaves. Later, tiny black dots can be seen in these areas. These minute, pepper-like dots are the fruiting bodies (pycnidia) of the causal fungus, and in them are produced the spores, as the seed-like bodies of the fungus are called, which spread the disease to new leaf growth. This disease is quite abundant every year, and, because of its susceptibility to the disease, the horsechestnut is not recommended as a shade tree. Lime-sulphur spray, 1-40, or sulphur dust have been used with greater success in the control of horsechestnut leaf blotch than Bordeaux mixture, since the sulphur compounds stick to the smooth foliage better than does the Bordeaux mixture.

Leaf Scorch

Leaf scorch is extremely common on hard maples, and is occasionally found on white oaks and other trees. This trouble is not of a parasitic nature but is usually the result of soil and climatic conditions. The rapid growth of the leaves during a wet period leads to the production of a large area of tender leaf surface. When hot, dry weather ensues, the root systems of the trees are not able to furnish enough water to

equal the great amount lost through transpiration. As a result, the leaves die. The type of injury shown by the leaves is an index to the cause of the trouble.

It will be noticed that the brown areas are found along the edges of the leaves and between the veins, not along the veins as is often the case with parasitic diseases. Leaf scorch is most serious in years when rainfall is scanty, and hot winds are frequent.

To prevent leaf scorch, watering around the trees is the logical recommendation. The water should be applied at some distance from the base of the tree, since the spread of the root system is at least

Figure 2.
A. White oak showing the effect of water deficiency.
B. Various stages of leaf scorch of hard maple leaves.

equal to the spread of the branches. If the trees have shown leaf scorch quite regularly in previous years, it may be well to trim the trees so as to reduce the foliage area from 15 to 25 per cent. If the pruning is done judiciously, the appearance of the trees will not be injured, and in some cases may be enhanced. All pruning cuts should be kept painted until healed to prevent heart rots from occurring.

Summary

In practically no case is there need to fear for the life of trees attacked by the common leaf inhabiting fungi. Such trees are unsightly and on first examination may appear to be dying, but such is rarely the case. The trees are injured by the loss of the leaves, but in most cases they recover without apparent loss of vigor. A tree should not be assumed to be dying and should not be cut down because the leaves are dying. Make a thorough examination and the type of trouble can usually be readily determined. Certainly, no tree should be sacrificed until it is plainly evident that the inner bark of the trunk and main branches is dead.

RECOMMEND SOIL TREATMENTS FOR FALL GRAINS

Increased Yields Follow Proper Soil Management Practices

BY G. M. GRANTHAM, SOILS SECTION

The question which usually confronts us at this time of the year is; what shall we do to the wheat or rye ground this summer in order to reduce the cost of production of a bushel of grain. When such questions are being considered, it is well not only to consider the wheat and rye crop but those crops which are to follow for the next few years. Probably, no crops, which are included in general farming, are more responsive to good soil management than are the fall seeded grains, and there rarely occurs a better place to start into a systematic soil building program than the period previous to the seeding of a fall crop.

Soils for Fall Grains

Wheat and rye crops are seeded on practically all series of soils, which may range from those of low productivity to those of high productivity. Light textured soils as a rule give low wheat yields and slightly better rye yields, yet, where good management is practiced, the yields on the lighter soils approach very near the yields given by the loams and silt loam which are usually considered to be the best producing soils for small grains.

Early Plowing and Packing of Seed Bed Are Advisable

Reports from carefully conducted experiments show it is advisable to plow early and pack the soil soon after plowing. This practice holds especially true for wheat. The early plowing makes conditions more ideal for the destruction of weeds and a better chance for a uniform and well compacted seed bed.

Lime

Lime is essential for most economical production of wheat, and rye also responds well to lime applications. The greater part of the lighter soils on which wheat is grown are acid in reaction and an application of some form of lime previous to the seeding of small grain is an excellent place for this branch of soil management.

The heavier types of soil which are used for wheat growing usually carry sufficient lime for this crop, however, should the heavy soils be acid in reaction, lime should be applied.

Fertilizers

Fertilizers are now considered almost essential for the most economical production of fall sown small grains. The more vigorous plants produced by fertilization are better adapted to withstand destructive winter weather than plants which do not receive fertilizer.

On a Fox sandy loam soil in southwestern Michigan, the stand of wheat in the spring of 1927 was over 90 per cent less on an untreated soil than on the similar soil where lime and fertilizer had been used.

What brand, what analysis, and how much fertilizer per acre are questions usually asked. Little can be said regarding the brands, however, if one has been using a special brand with good results it is advisable to continue with that same brand. The analysis to be used depends to a great extent on the soil and its previous treatments. On the lighter soils which are low in productivity, a 4-16-4 or a 2-16-2 are advised. On these same soils where manure or green manures have recently been used, an 0-20-0 usually causes a good increase in yield. On the low producing, heavy soils, a 2-16-2 or a 4-16-4 usually give good returns, while the better producing soils of the same group respond well to an 0-20-0.

In case a legume seeding is to be made in the small grain in the spring, the fall application of fertilizer should be made accordingly. The potash content of the fertilizer should be increased materially; a 2-12-6 or an 0-20-20 is used very often with good success.

In general, the amounts of fertilizer used on the light soils should be about 300 to 400 pounds per acre, while on the heavier soils the amounts are usually reduced to about 250 pounds per acre.

Spring applications of nitrogenous fertilizers on the lighter types of soil have proved to be a profitable practice and should be given consideration when planning the fertilizer program for the farm.

Manure

Quite often barnyard manure is used for the wheat crop. Where manure is plowed under for wheat or rye, it should be supplemented

Fig. 1.—Results of lime and fertilizer on wheat in early spring. 1. No treatment. 2. Limestone. 3. Limestone and complete fertilizer.

with an application of super phosphate. The top dressing of small grains during the winter with light applications of manure is usually profitable. This method of handling the manure often conserves some of the elements of fertility which might be lost if the manure was stored for later applications.

Table 1.—Results from use of lime and fertilizers on a Fox Sandy Loam soil in Cass County.

Treatment	Average yield per acre of 6 wheat crops grown in four year rotations
No treatment	7 57 bu.
6300 lbs. limestone (one application in 11 years)	18.78 bu.
6300 lbs. limestone (one application in 11 years) and complete fertilizers applied at intervals in rotation	30.3 bu.

FURTHER STUDIES OF POTATO HOLLOW HEART

Proper Cultural Practices Lessen Percentage of Tubers Affected

H. C. MOORE AND E. J. WHEELER, FARM CROPS SECTION

Investigations of the hollow heart of potatoes conducted in 1925 and 1926 were continued in 1927. The main objects of the 1927 experiments were: (1) To determine the effects of nitrogen, phosphorous, and potash used separately and in various combinations on hollow heart and yield; (2) to determine the effect of water on hollow heart development and on yield; and (3) to determine to what extent hollow heart may be controlled by close planting.

The experiment was conducted at the Michigan State College, on a sandy loam soil. Certified Russet Rural potatoes were planted June 20 on a three year old alfalfa sod which was plowed under early in the spring. No stable manure was applied. The fertilizer applications were at the rate of 1,000 pounds per acre and were based on a fertilizer analyzing three per cent nitrogen, twelve per cent phosphoric acid and four per cent potash. The fertilizer was applied broadcast and worked into the soil immediately after planting. Each fertilizer plot consisted of four rows one hundred feet long on approximately one-thirty-sixth of an acre and was replicated twice. Six plots, one-thirty-sixth of an acre each, were not fertilized and were used for checks.

September 22 to 24, 108 hills were dug in each plot. The weight of tubers and the percentage of hollow heart were recorded for each hill. Table 1 gives the results obtained. A similar fertilizer experiment was conducted in 1926* and the results obtained are included in Table 1 for comparison.

With respect to the influence of the various fertilizer elements on yield, the results of the 1927 tests were quite similar to those of 1926. All fertilized plots outyielded the check plots with the exception of the plots treated with nitrogen alone, which yielded 29.89 bushels per acre less than the check plots. The greatest increases in yields were noted in the phosphorous-potash and the nitrogen-phosphorous-potash plots. The differences in yield between the fertilized and check plots were not as great in the 1927 tests as they were in the tests of 1926. This may be accounted for by the alfalfa sod plowed under for the 1927 plots. No organic matter was plowed under for the 1926 plots.

The effect of the various fertilizer treatments on the development of hollow heart were somewhat similar to the results secured in the 1926

*Hollow Heart of Potatoes, Michigan State College Quarterly Bulletin, Volume 9, No. 4, May, 1927.

Plot No.	Fertiliser treatment	1927 Results		1926 Results	
		Av. total yield per acre bushels	Av. per cent hollow heart by weight	Av. total yield per acre bushels	Av. per cent hollow heart by weight
1....	Check (no fertiliser)	194.07	7.76	125.34	7.29
2....	*Nitrogen	164.18	7.28	127 37	7.83
3....	†Phosphorous	205.13	6.64	159.94	6 67
4....	‡Potash	244.91	12 43	161 70	15.27
5....	Nitrogen plus Phosphorous	246 84	2.61	148.65	2 78
6....	Nitrogen plus Potash	244.33	10.05	167.70	10 72
7....	Phosphorous plus Potash	253.06	9 17	179.06	7.97
8....	Nitrogen plus Phosphorous plus Potash	253.82	0	200.37	5.59

*Nitrogen (nitrate of soda, 167 lbs. per acre).
†Phosphorous (16% acid phosphate, 750 lbs. per acre).
‡Potash (muriate of potash, 77 lbs. per acre).

tests. The highest percentage of hollow heart was found in the potash plots. The nitrogen-potash and the phosphorous-potash plots also showed high percentages of hollow tubers. The nitrogen-phosphorous plots had a relatively small amount of hollow heart. No hollow heart was observed in the nitrogen-phosphorous-potash plots. In this case, the results differ materially from those secured in the 1926 test. No satisfactory explanation for this difference can be given at this time.

August Rainfall Important

In the 1927 tests, water was applied to 12 plots by means of an overhead irrigation system, while 12 other plots received no irrigation. The amount of water applied by months was as follows: August 3.41 inches; September 1.90 inches. The rainfall for August was 0.21 inches (2.42 inches below normal) and for September 4.67 inches (2.05 inches above normal). The results of the experiment are given in Table 2.

Table 2

Treatment of plots	Average total yield per acre bushels	Average per cent hollow heart by weight
Irrigated	255.91	7.55
Not irrigated	134.29	0.78

The water applied in August, which was 3.41 inches or .78 inch more than the normal rainfall for August, increased the yield 121.62 bushels per acre and increased the hollow heart 6.77 per cent. The irrigation water applied in September is not believed to have had any effect on yield or hollow heart as the rainfall for September was 4.67 inches or 2.05 inches above normal.

In a similar experiment conducted in 1925*, it was found that irrigated plots that received approximately 2.80 inches of water in August (.75

*Hollow Heart of Potatoes. Michigan Agricultural Experiment Station Quarterly Bulletin, Volume 18, No. 3, February 1926.

inches above normal rainfall for that month) gave an average yield per acre of 351 bushels compared with 275.5 bushels per acre for the non-irrigated plots.

The average per cent of hollow heart by weight for the irrigated plots was 10.37 and for the non-irrigated plots 1.09. The rainfall of August, 1925, was 2.15 inches (.48 inch below normal).

Unpublished data of an irrigation experiment conducted in 1926 gave practically no difference in yield on per cent of hollow heart, between irrigated and non-irrigated plots. In that test, 2.31 inches of water was applied to the irrigated plots in August. The rainfall of August, 1926, was normal and both the irrigated and non-irrigated plots showed relatively high percentages of hollow heart.

In the 1927 experiment, a study of 360 individual hills in the irrigated plots and a like number of the non-irrigated plots showed that hills in the irrigated plots averaged .54 more stalks per hill; 1.76 more tubers; .96 pounds more tubers, and 4.26 per cent more hollow heart.

Closer Planting Controls Hollow Heart

Plots with hills spaced 36 x 36 inches apart were compared with plots having hills 36 x 18 inches apart. In this test, the 36 x 18 inch spacing gave an average of .44 more stalks per plant; 61.30 more bushels per acre of U. S. No. 1; 10.04 more bushels per acre of U. S. No. 2; and 5.43 per cent less hollow heart than the 36 x 36 inch spacing. The results of the experiment are tabulated in Table 3.

Table 3

Treatment	Spacing distance inches	Yield per acre U.S. No. 1 bushels	Yield per acre U.S. No. 2 bushels	Total yield per acre bushels	Average per cent hollow heart by weight
Not irrigated	36x36	113 73	5 85	119 58	1 06
Not irrigated	36x18	154.86	19 33	174 19	.51
Irrigated	36x36	208 43	7 82	216.25	12.70
Irrigated	36x18	289 90	14 41	304 31	2 39

In the 36 x 36 inch spacing tests, plots were planted with one seed piece per hill and compared with plots planted with two seed pieces per hill. The seed pieces averaged two ounces each. In this test two pieces per hill gave an average increase in tubers of .35 pounds per hill and 3.29 per cent less hollow heart.

Large Seed Pieces Decrease Hollow Heart

One ounce, two ounce, and three ounce seed pieces were planted in separate plots with hills 36 x 36 inches apart. Seed potatoes uniform in size and shape were selected for the experiment.

Two ounce seed pieces gave an average of 1.22 more stalks per hill, 8.08 per cent less hollow heart and .37 pounds more tubers per hill than the one ounce seed pieces. Three ounce seed pieces gave an average of .97 more stalks per hill; 5.74 per cent less hollow heart and .38 pounds

more tubers per hill than the two ounce seed pieces. Table 4 gives a summary of the results.

Table 4

	1 oz. seed piece	2 oz. seed piece	3 oz. seed piece
Average number stalks per hill—irrigated	2 32	4 50	5 00
Average number stalks per hill—non-irrigated	2.62	2 88	4.33
Average number tubers per hill—irrigated	5 11	6 87	8.14
Average number tubers per hill—non-irrigated	4 62	6 00	7 55
Average weight tubers per hill pounds—irrigated	1 45	2 51	2 75
Average weight per hill pounds—non-irrigated	1 70	1 38	1.90
Average per cent hollow heart—irrigated	27 84	11 48	0
Average per cent hollow heart—non-irrigated	0	0	0

At Rossman Brothers' Farm, Lakeview, Michigan, a size of seed piece test was conducted, using one-half ounce, one ounce, one and one-half ounce, and two ounce cut seed and whole seed, averaging two to three ounces in weight. The growing season was quite dry and hollow heart was of no consequence. However, plots planted with the one-half ounce seed pieces gave 4.7 per cent hollow tubers.

The average yields per acre from the different size seed pieces were as follows:

One-half ounce	108.72 bushels
One ounce	153.17 bushels
One and one-half ounce	142.85 bushels
Two ounce	152.85 bushels
Two to three ounces whole	151.05 bushels

Giant Hill and Hollow Heart

Russet Rural tubers were selected in the fall of 1926 from giant hill plants and were planted June 19, 1927, in comparison with tubers selected from apparently healthy plants. The plots were on a sandy loam soil of medium fertility and were not irrigated. Rainfall during the growing season was approximately five and one-half inches below normal. The spacing of hills in both plots was 36 x 36 inches.

The plots were harvested September 25. Results of the test are recorded in Table 5.

Table 5

	Giant Hill	Healthy
Average number stalks per hill	2 14	3 66
Average number tubers per hill	3 42	4 66
Average weight tubers per hill, lbs	1 31	1 38
Per cent of hollow heart	16 9	0
Stalks having giant hill characteristics	66 6	0

The healthy hills averaged 1.52 more stalks per hill, 1.24 more tubers and .07 pounds more of tubers than did the giant hills. No hollow heart was found in the healthy plants while the giant hill plants averaged 16.9 per cent hollow heart.

The characteristics of giant hill plants are uprightness and stiffness of stalks, with relatively few stalks per hill; coarse vine and root growth with generally few tubers per hill which usually are rough and oversized. Giant hill plants remain green late in the season and do not succumb to frost as quickly as normal plants.

Conclusions

Hollow heart of the Russet Rural potato is likely to be serious in seasons when the rainfall of August is normal or above normal. Deficient rainfall in August tends to check development of hollow heart.

Potash applied alone tends to delay the maturity of the vines and to increase the percentage of hollow potatoes.

A complete fertilizer of a 3-12-4 analysis has given increased yields without increasing the per cent of hollow heart potatoes. Growers can profitably use complete, well balanced, fertilizers to better the yields and quality of the potato crop.

Closer spacing of the hills has proved one of the most effective means of improving the market quality of potatoes by reducing hollow heart and increasing the yield of medium sized, well shaped potatoes. The distance of spacing hills will depend upon the fertility of the soil, weather conditions, and other factors. With satisfactory soil conditions, the maximum spacing distance recommended for the Russet Rural variety is 36 x 18 inches. The practice of check rowing potatoes 36 x 36 inches apart should be discontinued as it favors the production of oversized, ill-shaped, hollow potatoes.

Large seed pieces are a factor in lessening the percentage of hollow potatoes and in increasing yields. It is recommended that growers plant seed pieces that average approximately two ounces in weight, using about 20 bushels of seed per acre.

Potatoes from giant hill plants may be seriously affected with hollow heart. A small percentage of giant hill plants in a field may cause a relatively high per cent of hollow heart in the total output of the field.

It is recommended that growers of table stock potatoes plant certified seed and that they rogue their fields late in the season to remove giant hills.

Since hollow heart is usually most serious in over-sized, irregular potatoes and those with growth cracks, special effort should be made to sort out such stock as the potatoes are being graded for market.

THE SPRUCE TORTRIX DAMAGES ORNAMENTAL TREES

Control Methods Recommended by Entomological Section

BY E. I. MC DANIEL, ENTOMOLOGICAL SECTION.

The Spruce Tortrix *Oletreutes abietana* Fern. seems to be on the increase all over the state. So far as our observations go, it appears that this insect confines its attacks to Englemann spruce and blue spruce, and is widely distributed throughout the spruce growing areas of the northeastern United States, from Colorado east to New England. In certain localities, it has been known to inflict severe injury upon isolated trees.

There are two generations each year, and the winter is passed either as mature or nearly mature larvae. Adults are on the wing about the time the new growth measures an inch or more in length.

The mature larvae measure about one-third inch in length and are somewhat transparent, several shades lighter in color than the pinnules on which they feed. The head, thorax, and anal shield are brown or brownish-green. The body appears naked, though in reality there are a number of light-colored hairs scattered over the surface.

The larvae start life as leaf miners and probably pass the winter inside of hollowed out pinnules, and, in order to afford themselves more complete protection, they web the empty pinnules together. In a short time, the web contains not only hollow pinnules but quantities of chewings and frass as well. The webbing is peculiar in that it has more of the appearance of spider work than that of a caterpillar and it usually has a sooty appearance.

The nest is so compactly built that it sheds water or contact sprays, and, since the larvae are mostly leaf miners, poisons are not effective.

As a general rule there is only one larva to a nest, though, when large nests two or three inches long occur, several larvae may occupy the web together. About the time the larvae reach maturity, the hollowed pinnules on the outside of the nest, begin to turn brown, rendering the nest still more conspicuous and unsightly.

Pupation takes place within the nest where the larvae have fed, the larvae spinning tough compact cocoons. The pupal stage is of short duration and, from each small, greenish brown pupa, a tiny inconspicuous moth, which measures from 20 to 23 mm. with wings expanded, emerges. The moth is grayish-brown in color and is marked with inconspicuous silvery white bands.

The nests occur most commonly on the terminal growth and are most numerous on the lower part of the tree.

The only control measure which has given any satisfactory results is to cut the nests off and burn them before the adults emerge. This

Typical Example of work of Spruce Tortrix.

can be done in October or November or even in the very early spring before growth is too far advanced.

It is barely possible that a dormant application of an oil emulsion or a miscible oil, if applied with pressure, would give some control when applied in the spring before growth starts.

FACTORS AFFECTING FARM INCOMES STUDIED

Organization and Proportions of Enterprises of Farm Business Are Important

BY E. B. HILL, FARM MANAGEMENT SECTION

It is the purpose of this article to discuss factors within the control of the individual which affect the returns from the farm business. Too often, we think of methods and practices in farming rather than the organization of the business and the relation of one enterprise to another and to the entire farm business as a unit.

In general, progress made in solving the problems of agriculture may be considered from two angles, first, what the individual farmer can do to increase the income from the land and facilities under his control and, second, aid obtained through organized agriculture by legislation and cooperative activities. One is equally as important as the other. Aid through group action is slow at the best, progress through the efforts of the individual in making best use of the resources within his control, however, may often be made during the year's business. Thus, it would seem that one of our responsibilities is to see that our own business is well organized and conducted on a scientific basis.

During the spring of 1928, a farm organization study was made of 114 farms in Benton and Oneida Townships, Eaton County, by the Farm Management Section of this Station. This area in central Michigan is a general farming region in which dairying (market milk) and cash crops predominate. It is generally considered to be a little better than the average of the farming regions of southern Michigan. In general, the farm buildings were painted and in such a condition as would give the appearance of a good agricultural region.

The predominating soil types in the area are Miama silt loam and sandy loam. The topography varies from gently rolling to hilly, with the former predominating. The growing season averages from 150 to 160 days, elevation about 850 feet and with an annual precipitation of about 32 inches. According to the Soils Section, about 50 to 60 per cent of the soil in this area is too acid to grow clover and alfalfa successfully.

The purpose of the survey was to study the factors which affected the returns from the farm business, with special reference given to farm organization, such as size of business, numbers and kinds of livestock, acres and kinds of crops, and yield and production records. In this article, the effect of size upon the returns will be discussed. Other factors will be considered in subsequent issues of the Quarterly Bulletin.

There are many measures of size in the farm business. The ones

used in this study were, (1) capital invested, (2) acres in farm operated, (3) acres in crops, (4) number of cows, (5) man equivalent, and (6) number of power units.

The measure of size most often used by farmers and others is simply the number of acres in the farm. This is in many cases a very poor yardstick, since many farms of 80 acres are doing as much business as a 120 acre farm. Yet some would call the former a small and the latter a medium sized farm.

In order to compare like sized farms with each other, an attempt was made to sort out the various groups. Group A included farms of 37 to 60 acres, B from 61 to 100, C from 101 to 140, D from 141 to 180, E from 181 to 220 and F included farms of 221 and over.

Table No. 1 in a general way shows the relation of size of business to farm income.

Table 1.—Data from Eaton County survey showing size of farm business and measures used, together with comparative returns from the various groups.

Group	Total	A	B	C	D	E	F
No. of farms	114	13	32	35	16	7	10
Range in acres		37–60	61–100	101–140	141–180	181–220	220 over
Av. investment	$11535	$6089	$7964	$11065	$13736	$15296	$24938
Acres operated	131	49	84	125	159	202	s06
Acres in crops	76	34	51	80	88	111	148
Number of cows	6	4	5	6	7	9	12
Man equivalent	1 4	1 1	1.1	1.4	1 6	1.9	2.25
No. power units	4	3	3	4	5	6	6
Receipts & Net Increases	$2508	$1558	$1805	$2386	$2981	$3310	$4989
Expenses & Net Decreases	1322	763	868	1246	1560	1901	2886
Farm Income	1186	795	937	1140	1421	1409	2103
Rate earned on investment, %	4.0	1.3	2.7	3.8	5 1	4.5	5.5
Operator's labor income	$615	$491	$538	$585	$742	$728	$856

Table 1 shows that the higher income was obtained on the farms on which the business was somewhat larger than the average. Group D, 141 to 180 acres, was the first group to exceed the average income of the 114 farms. This is also the first group to exceed the average insofar as size of business is concerned.

It should be stated, however, that the range in farm income was much greater between farms of the same group than it was between the average of the various groups. By this is meant that some farmers on the smaller farms made a larger income than did some farmers on the larger farms. Thus, the farmer on the small farm should not consider the small farm too much of a handicap. However, to obtain a satisfactory income on a small farm greater skill is needed than on a farm somewhat larger than the average. One of his problems is to increase the size of his business, either through adding more land, more livestock, minor enterprises, or through intensifying his business.

It may be observed from the table that, as the size of business increases from group to group, the receipts plus net increases in all cases, increase at a faster rate than the expenses plus net decreases.

Within each of the groups where the number of acres farmed was

about the same, the increase in size of business was usually obtained by raising more livestock. The more successful farmers had from 50 to 100 per cent more livestock, mostly cattle, than did the less successful operators.

While it was not the purpose of the survey to study farm income figures, it was necessary to obtain them as a guide in determining the most profitable type of farm organization. Too often, farm income figures are given too much publicity, forgetting that their main use is to serve as a guide in the analysis of the farm business.

The average farm income on the 114 farms was $1186 plus the food and fuel furnished by the farm and used in the farm home. The estimated value of the house, and resulting depreciation, interest, insurance, and taxes on it were deducted from the farm business. Thus the farm business is neither charged or credited with the dwelling.

The $1186 farm income is the return from the investment and from the labor and management of the operator. To obtain the operator's labor and management wage a charge of five per cent on the investment was deducted from the farm income. To obtain the rate earned on investment an allowance of $720 for the operator's labor was deducted from the farm income and the balance divided by the total investment in the business.

The average return from the investment on the 114 farms after allowing $720 for operator's labor was four per cent. The range of averages of the various groups was from 1.3 per cent for the small farms to 5.5 per cent for the larger farms. Returns on investment, however, are more significant on the large farms than on the small ones.

The average returns from operator's labor and management, after deducting a charge of five per cent on the investment from the farm income, was $615. Labor income is more important to the smaller farmer with a lower investment than it is to the larger groups with 300 to 400 per cent greater investment.

The business on some farms was small due to the age of the operator, who, no longer needing to work as much or as hard as formerly, farmed less intensively according to his needs.

In the survey, many farmers were found who were increasing the size of their business through renting crop or pasture land, through adding more livestock, through adding or increasing the size of minor enterprises such as poultry or hogs. This aids in increasing the receipts without a proportionate increase in expenses, and usually provides a better labor distribution. On the other hand, a few farmers were found who were reducing the size of business to balance with their labor supply and other limiting factors.

It should not be understood from this article that "size of business" or "a big business" is always the major factor affecting farm income. A proper proportion or balance of all factors is desirable. There are other factors such as balance of crops and livestock, kind of crops, yields and production, farm expenses, labor efficiency, which are often equally important and which will be presented in future publications of this Station.

A STUDY OF INCREMENT GROWTH AFTER THINNINGS

Timber Produced More Rapidly in Well Managed Woodlots

BY PUTNAM W. ROBBINS, FORESTRY SECTION

A growth study of thinned hardwoods has been made on a portion of one of the Michigan State College woodlots. The object of the study was to determine the periodic annual increment of a hardwood stand which had been thinned and managed according to accepted silvicultural methods.

A permanent sample plot of one acre was laid out in 1925, within an area which had been thinned in 1914. The topography of the entire area is gently rolling to level and the soil is a deep sandy loam.

The cutting in 1914 removed all brush, grape vines, and dead and down timber, all of the larger trees, and trees of undesirable form, species, and condition.

In March, 1925 the trees on the plot which were one inch in diameter and above were measured at four and one-half feet above the ground. The measurements were recorded by species and after each tree had been measured it was marked with paint. From the measurements, it was found that the largest number of trees were in the two-inch diameter class with the three-inch class coming second. However, the largest volume occurred in the seven-inch class. The total number of trees on the plot in 1925 was 751. The total volume of the plot was 2,591 cubic feet. The volumes were figured by diameter classes using a volume table* for hardwoods in southern Michigan, which gave the volumes in cubic feet per tree for the different diameter classes.

In March, 1928, this sample acre was remeasured. The total number of trees on the plot were 678, a decrease of 73 since 1925. This decrease in number occurred almost entirely in the one and two-inch classes. Suppression and death in these diameter classes was due to competition from the larger trees. The largest number of trees were in the two and three-inch diameter classes, the same as in the measurements in 1925, but the largest volume shifted from the seven-inch to nine-inch diameter class. The total volume of the plot showed a considerable increase, being 3,025 cubic feet, an increase in volume of 434 cubic feet per acre. Thus the periodic annual increment was 144.6 cubic feet. The total increase in volume may be represented in cords by dividing by 90, there being approximately 90 cubic feet of solid wood in a standard cord of wood. Thus the total increase in three years was 4.8 standard cords, or 1.6 standard cords per year. This

*"Improvement of the Farm Woodlot," by A. K. Chittenden, Michigan State College, Special Bulletin No. 122.

Table 1.—Per cent of each species by number of trees and volume in cubic feet, 1925.

Species	Number of trees	Per cent of total number	Per cent of total volume (cu. ft.)
Hard maple	419	55.8	33.1
Black cherry	67	9 0	18 5
Basswood	37	4.9	14.2
Red oak	44	6.0	11 1
American elm	20	2.6	4 9
Beech	42	5 6	4.2
Bitternut hickory	31	4.1	3.4
Soft maple	46	6 1	2 3
Birch	10	1 3	1 9
Sassafras	9	1 2	1 8
Ironwood	7	9	1 6
Black walnut	11	1.5	1 4
White oak	1	.1	8
White ash	5	.7	.7
Cork elm	2	.2	1
Total	751	100%	100%

rapid growth and increase in volume indicates a fairly well balanced and vigorous condition within the stand.

The present volume of the standing timber on this sample acre is 3,025 cubic feet or 33.6 standard cords. Thus, by dividing the periodic annual increment by the volume per acre, 33.6 cords, and multiplying by 100, we get the growth per cent, which equals 4.7 per cent. This rate of growth of 4.7 per cent is rapid for hardwood stands and is encouraging in the light of facts regarding growth in the average Michigan woodlot. "The average Michigan woodlot is probably producing less than half a standard cord of wood or its equivalent in board feet per acre per year."*

The conditions on this sample plot are ideal in comparison with the average woodlot in Michigan. The thinning gave plenty of room for crown and root development, and nowhere in the crowns are there large openings which admit enough sunlight to cause drying out of the ground.

Another explanation for the vigorous growth on this plot is the freedom from insect and fungus damage. The cleaning given the area destroyed most of the fungus fruiting bodies, because all dead and decaying material was piled and burned instead of being allowed to decay on the site.

The amount of wood produced per acre depends not only upon the rate of growth, but also upon the total volume of standing timber per acre. Thus, if the total volume on this sample acre had been smaller, that is, if the stand was understocked, the periodic annual increment would have been much smaller. Therefore, the relation between growing stock and rate of growth must always be considered and a proper balance maintained in order to secure the maximum periodic annual increment.

This plot has a growing stock of 3,025 cubic feet per acre. This combined with the growth rate of 4.7 per cent gives the splendid increase in volume.

*"Improvement of the Farm Woodlot," by A. K. Chittenden, Michigan State College, Special Bulletin No. 122.

Similar rapid growth may be secured on the average farm woodlot in Michigan if the owners will conduct thinnings and put their woodlots in good condition.

ELECTRIC MOTOR DRIVES ELEVATOR AND GRINDER

Livestock Feeder Has Successful Grain Handling Machinery

BY O. E. ROBEY, AGRICULTURAL ENGINEERING SECTION

One of the patrons on the Mason-Dansville experimental electric line feeds a large number of lambs, and has quite a large dairy herd. In remodeling his feeding barn, he installed a large bin for the storage of purchased grain. This bin extends from about six feet above the floor to nearly to the top of the barn, and it holds about three carloads of grain. In addition, there are two other smaller bins, one for home grown grain, and the other for mixing feed.

This man had some second hand elevator equipment which he wished to make use of in filling these bins. He asked this department to co-operate with him in working out a plan for installing this equipment. An electric motor was to be used for power, and it was desired that the same motor be used to grind grain for feed.

Fig. 1 is a diagramatic layout of the bins and machinery. The elevator consists of two belt and bucket conveyors, such as are used in flour mills, and an auger is used to convey the grain sideways. Ordinarily, this type of elevator is driven from the top pulley, but in order to eliminate long belts an attempt was made to drive the elevator from the bottom. One conveyor was driven from the bottom, and the belt of this conveyor was used to drive the other conveyor from the top. There was some slippage and clogging but practically no difference in this respect was noticed between the two conveyors.

In order to get the proper reduction in speed between the motor and elevator, a worm drive pump jack was used. This pump jack had a speed reduction of sixteen to one.

The motor was located so that by changing a belt either the pump jack or grinder could be operated.

The feed grinder, a six inch burr mill, was set high enough so that the ground feed could be run directly into a feed car or bin which was located adjacent to the feed alley of the dairy barn.

The motor in this installation is a one horse power, single phase, 220 volt. It has been used to elevate grain and to grind feed during the past winter.

A carload of grain, weighing 59,500 lbs. was elevated into the large bin, a distance approximately of 25 feet, at the rate of two and one-half

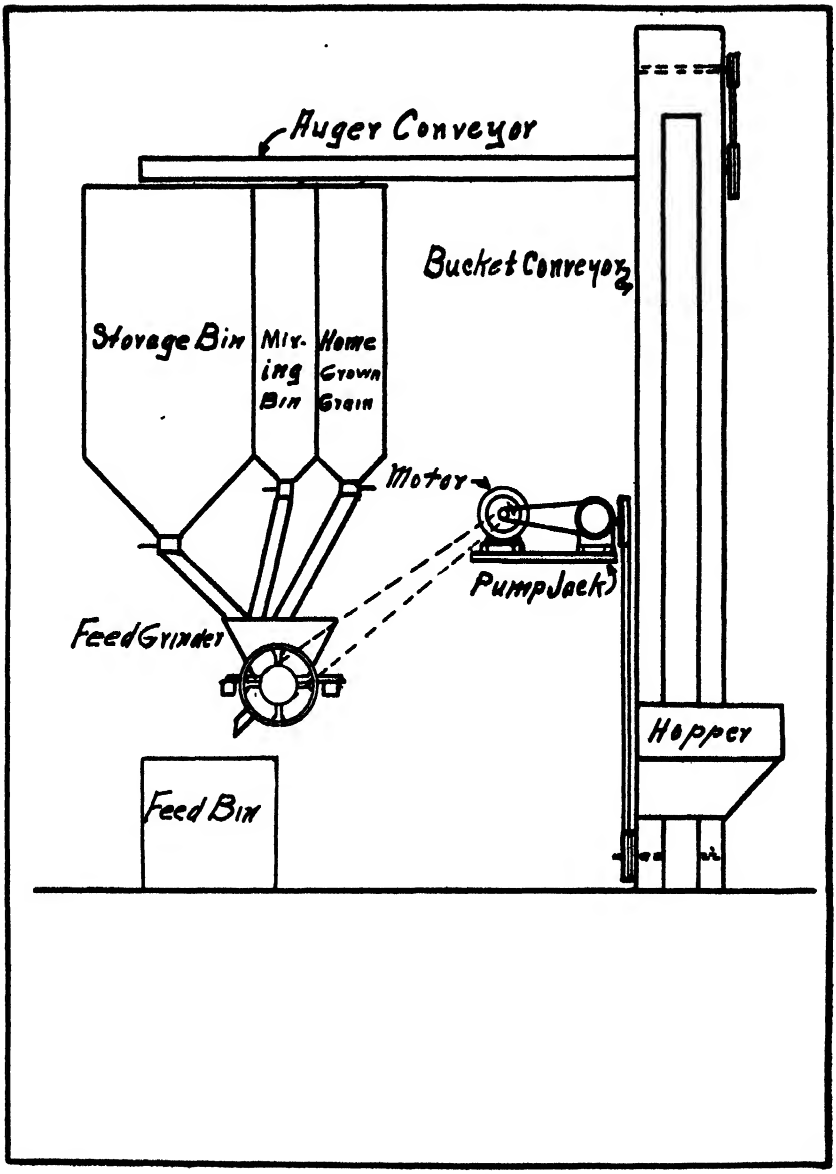

Fig. 1.—Electrically operated elevator and grinder.

bushels a minute. The motor in elevating this car load of feed used 13 kilowatt hours of current, costing approximately thirty-nine cents.

With the one horse motor the burr mill has a capacity of about 100 pounds of ground feed per hour.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

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Regular Bulletins—

251 Insects of 1907.
258 Insects of Field Crops.
262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
273 Utilization of Muck Lands.
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

58 Foul Brood.
65 Hog Cholera and Preventive Treatment.
71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
74 Analysis of Some Materials Sold as Insecticides and Fungicides.
76 Transferring Bees.
79 Michigan's Shifting Sands; Their Control and Better Utilization.
80 Yellow Rocket (a dangerous weed).
82 Durability of Concrete Drain Tile No. 11.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
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99 The Detroit Commission Plan of City Milk Administration.
100 Soy Beans.
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110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
116 The Agriculture of the Upper Peninsula of Michigan.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
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123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
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131 Tomato Growing in Michigan.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
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137 Marketing Michigan Potatoes.
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143 Winter Pruning the Black Raspberry.
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145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
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159 Production of Ice Cream With a Low Bacterial Count.

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53 Standard Fertilizers for Michigan.
55 Lime Requirement for St. Joseph County.
56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paving for Milk on a Quality Basis as a Means of Improving the Supply.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it upon the receipt of ten cents (coin or stamps).

*Bulletins listed in bold faced type are recent publications of this Station.

62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
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71 Fertilizer Suggestions for Barry County Soils.
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12 Hot Lunch Club.
15 Food Study Club Work.
16 Michigan Club Songs.
17 Dairy Club Work.

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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
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FACTORS AFFECTING THE FARM INCOME*

*This article is the second of a series of articles to appear in the Quarterly on "Factors Affecting the Farm Income." The first was published in the August, 1928, issue.

The Amount of Livestock Kept and the Production Per Animal Influence the Financial Success of the Farm

E. B. HILL, FARM MANAGEMENT SECTION

Most of the more successful farmers in Central Michigan keep from 25 to 50 per cent more livestock than the less successful and, through a better grade of stock efficiently cared for, obtain a higher return per animal unit. In some cases they have more dairy cows, in others more hogs or sheep, or poultry,—or a combination of two or more of these enterprises. These facts were determined by the Farm Management Section of this Station after a careful analysis of the records of the year's business on 114 farms in Benton and Oneida townships, Eaton county, for the year 1927.

The type of farming practiced in this area is general farming in which dairying, supplemented by wheat and beans as cash crops, predominates. This type of farming is similar to that found in many other central Michigan counties. The soil types are mainly loams, silt loams, and clay loams of the Miami type.

In the August, 1928, issue of the Quarterly Bulletin, the effect of size of business on the income from these farms in Eaton county was presented. It was shown that the most satisfactory returns were obtained from farms where the size of business was somewhat larger than the average of the group. Measures of size discussed were,—total acres in farm, amount of capital invested, number of cows, number of men employed, and number of power units.

The total amount of livestock, combined with production per animal, has an important bearing upon the financial success of the farmers in this area in Central Michigan. It may be observed from Table 2 that the more successful groups not only kept more livestock but the production from each class as measured by the gross income per cow, sow, ewe, or hen was higher except in a few cases where the enterprise was of minor importance. This larger size of business plus higher production per unit accounts for a considerable portion of the larger income of the more successful groups.

Balance in the Farm Business

The major livestock enterprise for the entire region is the dairy, which was the source of 61 per cent of the total receipts from livestock. Sheep supplied 15 per cent, hogs 13 per cent, and poultry 10 per cent of the livestock receipts.

The best indication of the relative importance of sales of crops and livestock in this area is provided in Table 1, which shows the percentage that crop sales and livestock sales are of the total farm receipts. Farmers who

Fig. 1.—This herd of nine cows represents the average number of cows found on the more profitable farms in the 141 to 180 acre group in Benton township, Eaton county. The returns from cattle, comprised 61 per cent of the total livestock returns and 35 per cent of the total farm receipts.

obtained a considerable portion of their income from outside sources such as from operating threshing machines, hauling milk and hauling gravel were not included in this table.

A summary of the returns from all of the 114 farms shows that 36 per cent of the total receipts came from crop sales and 57 per cent from livestock sales plus net increases in livestock. On the more successful farms, however, a larger proportion of the income was derived from livestock and a smaller proportion from crop sales than was obtained by the average of the group. Thus, for the most part it seems desirable as a basis for this area to obtain about one-third of the farm income from crops and two-thirds from livestock. Specialties on different farms may considerably change this ratio. Much depends on the operator of the business.

Table 1.—The relative proportion of crop sales and returns from livestock on the higher and lower profit farms in Eaton county, Michigan.

Group size - acres	Percentage that crop sales are of total income		Percentage that receipts and net increases* of live stock are of total income	
	Higher profit farms	Lower profit farms	Higher profit farms	Lower profit farms
37-60	22	51	66	45
61-100	36	31	60	64
101-140.	32	30	64	54
141-180	28	48	66	45
181 or over	28	38	66	59

*Difference between opening inventory plus purchases and closing inventory plus sales

The foregoing results may be due to the fact that with farms organized as they are at present in this area, the keeping of livestock induces higher labor, building, and capital efficiency as well as provides a satisfactory use for rough pasture land and a market for low priced roughages produced on the farm.

Amount and Kind of Livestock

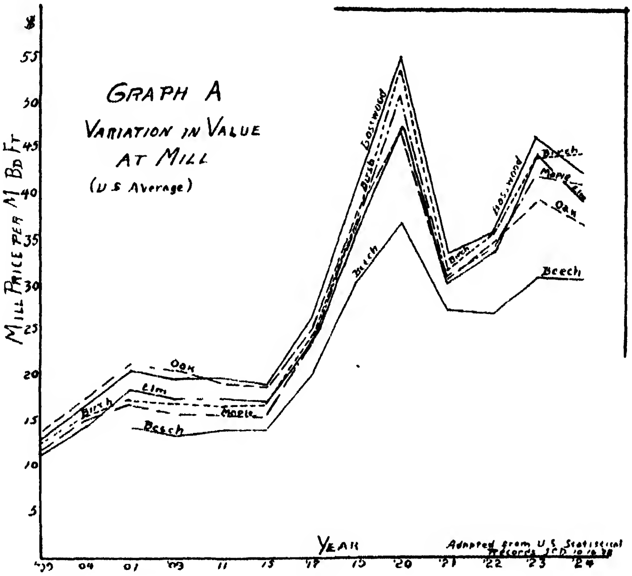
While the dairy enterprise was of major importance on most of the farms included in this study, on many farms the income from that source was exceeded by the combined receipts from the other livestock enterprises. As it happens, hog prices for the year ending March 1, 1928 were low. Thus, this enterprise did not contribute as much to the total farm receipts as would sometimes be obtained. Variation in emphasis on the different livestock enterprises depends upon the prices anticipated as well as on the type of soil and the contour of the land in so far as they affect the crops grown, the pasture and building facilities available, and the personal desires of the farmer.

On the farms ranging in size from 36 to 60 acres, 70 per cent of the livestock income came from cows, eight per cent from hogs, eight from sheep, and 15 from poultry. While on the 141 to 180 acre farms, 60 per cent came from the dairy, 17 from hogs, 15 from sheep and six from poultry. Thus a somewhat greater diversity is evident on the larger farm units. On the farms of smaller acreage, greater emphasis was placed on the dairy and poultry enterprises. These more intensive enterprises are necessary on the small farm as a means of increasing the size of the business by more fully utilizing the labor and capital.

Table 2 lists the number and kinds of livestock as well as the returns per unit on the higher profit and the lower profit farms of the various size groups. For example, the nine more successful farms in the 61 to 100 acre group had an average of six cows and 93 hens. Three farmers kept one brood sow each, and two kept an average of 25 ewes. On the nine less successful farms of the same size group, there were an average of four cows and 64 hens. Seven of the nine kept one brood sow and three kept an average of 20 ewes. The gross income per cow was $196 on the most profitable and $142 on the less profitable farms. The gross income per hen was $3.16 and $1.53, respectively.

ucts, with a wide variation in uses, specifications, and prices. It is with this 56 per cent that we are mainly concerned at this time.

The 1925 production of lumber in Michigan was 71 per cent hardwoods, of which maple constituted 64 per cent, birch 17 per cent, basswood six per cent, elm and beech each five per cent, and oak one per cent. Graph A shows the fluctuating mill prices for these species.



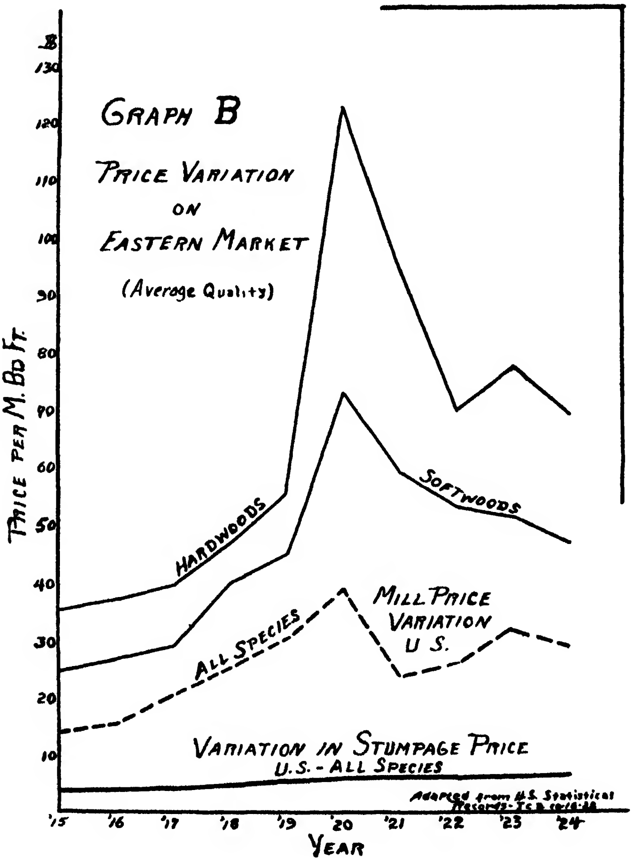
Prices

It will be noted that while all the species have followed in general the ups and downs of the lumber market, with a high peak in 1920, yet at the last reports (1924) there was considerable shifting of prices between species. The farmer, entering into the manufacture of lumber, faces an unsteady market for which he needs special information if he is to compete successfully with organized lumber interests.

Graph B shows the price history of lumber on the eastern markets. The variation would have been greater had the prices for first quality lumber been used but it is thought that "average quality" would come closer to the farm-grown product. It will be noted that, while both hardwoods and softwoods registered the 1920 peak of high prices, the hardwoods show considerably more variation. The hardwoods are the farmers' main concern in woodlot production.

There is a big difference in lumber value at the mill, as shown in Graph B, and on the eastern market at point of consumption. The price increases as more distributors become concerned in the handling of lumber, fluctuations become more acute and the transaction takes on more the nature of gambling, especially for the small producer who has a limited knowledge of trade conditions.

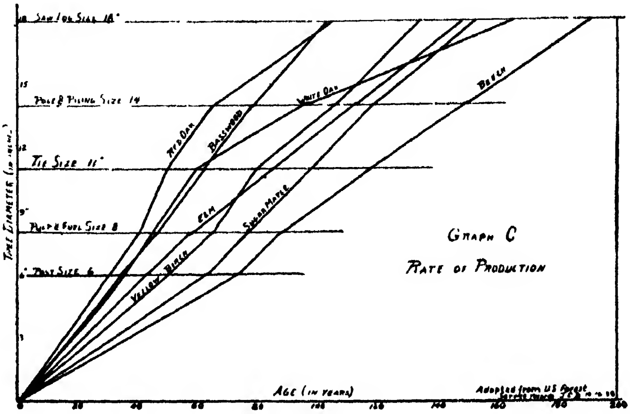
At the bottom of Graph B, is shown the variation in stumpage price. While it is probable that Michigan hardwoods, if we had the figures, would show more variation, yet the graph is fairly indicative of the fact that stumpage values have been rising very slowly in comparison with lumber values. The graph also shows that the rise, though slow, is not characterized by violent fluctuations in price as with lumber.



Woodlot stumpage is a fairly safe farm crop, which is produced at a minimum of expense and labor. Where the farmer is not satisfied with his stumpage price and embarks upon a mill venture in order to take advantage of the more rapidly increasing lumber values, he should first of all learn to know his market and to prepare his product according to the demands of that market. Just where the farmer should stop in the handling of his crop—from standing timber to logs, logs to rough dimension, rough to finished lumber, finish to consumer—is a problem of rapidly growing importance.

Price alone is not a fair index of timber crop value. The farmer, as with other producers, is concerned with production costs. Species vary

considerably in rate of growth, which is an important factor in determining costs. Graph C shows the rate of growth of the species included under Graph A.



Rate of Growth

Beech is shown by Graph C to be the slowest of the seven species in production of timber crop. In Graph A, the beech product (lumber) brings the lowest price. Yet beech forms a large percentage of the woodlot stands in what should be the better woodlots of southern Michigan. Where possible, basswood, birch, and maple should supersede the slower growing and less valuable beech, hickory, sassafras, black cherry, and ironwood. White oak grows so slowly, it does not pay to produce a commercial crop of it any more if red oak is available. Possibly the most important point indicated in Graph C is that red oak, basswood, birch, and maple are just getting nicely to a stage of vigorous growth when they reach the 18-inch sawlog size and they should be allowed to continue into veneer sizes.

Michigan State College has been of some assistance to the farmers of the State in helping them get better prices for their woodlot timber. The time has come when we need to go further. The farm woodlot should be taken seriously as a regular farm crop and accorded the consideration that is given to other crops. We need to assemble, coordinate, and uncover the essential facts of woodlot production which will enable us to put the timber crop on a business basis. We would like to have results from a large number of representative woodlots. It is hoped that the farmers of the State will co-operate with the College in making this study.

GET ALFALFA AND CLOVER SEEDINGS ON LIGHT SOILS

Summer Seeding in Stubble Proves Successful Four Successive Years

A. G. WEIDEMANN, SOILS SECTION

Those who have had experience with alfalfa and clovers on the light soils of Michigan know that seedings of these crops are as difficult to obtain as the crops are important. There are several methods for seeding these crops which have been used with varying degrees of success. In our sand land studies, however, we have found the seeding of the legume in stubble in late summer to have been successful four years in succession.

Perhaps the most common method of seeding these ccrops is that of seeding in spring with either fall or spring sowed grain. This method proves reasonably successful on the heavier types of soils which are capable of holding enough moisture to support two crops, but, too often, there is not enough moisture in sandy soils to support both crops and, as a result, the legume crop is sacrificed.

Another common practice, especially for sweet clover or alfalfa, is to seed them alone in June, July, or early August on recently prepared seed beds. This method has also proved very successful on the heavier types of soil, but, on the sandy soils which are easily shifted by the winds it is not uncommon for whole fields of new seeding to be destroyed by shifting sand. In many cases seeds, are uncovered or deeply buried before they have had a chance to germinate.

The practices of top dressing with manure or using a light seeding of grain, which should be clipped early in the season, have been recommended to prevent injury to the legume seeding by shifting sand. While these methods are partially successful, they have faults which are worth considering. The writer has tried both of the above mentioned methods without the desired degree of success. In the first place, either method makes it necessary for the farmer to sacrifice one season's crop. Second, even a light seeding of a grain crop would compete with the legume seeding for moisture; while, at the same time, the thinner the nurse crop, the less effective it would be in preventing injury from shifting sand. Third, while the manure top dressing tends to prevent sand from shifting with the wind and takes no moisture from the soil, it usually carries with it enough foul weed seeds to produce a crop of hardy vigorous weeds which would be just as great a competitor for moisture as any nurse crop.

Experimental Seedings

In experiments carried on in efforts to get seedings on the light sandy soils near Grayling, many discouragements were met until the practice of summer seeding in grain stubble was adopted. There is usually less moisture in the soil at that time than in early spring but the temperature condi-

tions are more favorable so that, if seeding is done after a rain, germination takes place quickly and in a very short time the rootlets are well on their way to the lower layers of soil where the moisture content is more constant. Such soils have such a low water holding capacity and it is so easy for water to penetrate them that it sometimes happens they are almost saturated to considerable depth after a July or August rain. Such moisture conditions would be ideal for summer seeding. The advantages of seeding in stubble are: First, the stubble prevents the wind from blowing the sand and thereby cutting off the seedlings; second, the stubble takes no moisture from the soil; third, the crop residue tends to decrease the amount of evaporation from the surface of the soil; and finally, it holds snow in the winter which forms a protecting blanket over the new seeding.

This method of seeding would probably be unsatisfactory in fields where large numbers of weeds are growing in the stubble as is very often the case on heavy soils, but those conditions are not so common on sandy soils, especially if the grain crop follows a well cultivated crop.

Kinds of Stubble To Use

In following the method of seeding in stubble, one finds advantages and disadvantages in different kinds of stubble. Rye, which is best adapted to light soils, leaves a very good stubble but it has the disadvantage of shattering somewhat and leaving seed on the ground which produces a crop that is not killed off in winter. Oat stubble is not so durable as rye stubble, while at the same time the oat crop ripens later, which necessitates later seeding of the legume. Any oats that shatter and grow will be killed by winter frost and will not interfere with the legume crop the following year. Perhaps the best stubble would be produced by growing peas and oats or some similar crop to be cut for hay before it ripens. In such a case, earlier seeding of the legume would be possible and there would be no ripe grain seeds to produce a catch crop which would compete with the legume seeding for moisture. Either rye or rye and vetch when cut green will leave a good stubble but they do not make as good hay as oats or oats and peas. By using any of these crops, either cut green for hay or allowed to ripen for seed, one is enabled to harvest a crop from a field the same year that the legume crop is started.

The idea of seeding in stubble was conceived by the writer in the summer of 1925. That year rye was removed, the soil lightly harrowed, alfalfa sowed, the soil harrowed again with a spike-tooth harrow, and then rolled with a heavy concrete roller. The results so far as the alfalfa seeding was concerned, were remarkable, although a catch crop of rye was also produced which had to be clipped. The following season, being an average one, the experiment was repeated with equally good results. The next year, 1927, the experiment was repeated with slight changes in procedure. That time the soil was loosened by going over it very lightly with a disc harrow. By so doing enough soil could be loosened to cover the seed without disturbing the stubble as much as by using a spring tooth harrow. The seeding was done on July 27, 1927, and, regardless of the fact that the rainfall at Grayling during the month of August, 1927, was more than two inches below normal, a perfect stand of alfalfa was secured.

In 1928, peas and oats were sowed in the spring and cut green about the middle of July, after which the stubble was slightly disced and one-half

of the area was seeded to alfalfa, one-half to sweet clover. In all experiments, the soil was rolled with a heavy concrete roller after seeding. On October 12, when the last observations were made, the stands of both alfalfa and sweet clover which had been seeded in stubble were remarkably good, while, in another field, the stand of sweet clover which was seeded in April, 1928, partly on bare soil and partly on soil which had been top-dressed with manure, was very patchy and largely obscured by a crop of weeds. The sweet clover on the high spots of the field where it was not protected by stubble, was completely destroyed by shifting sand.

Other Methods

Another method of procedure, which appears to be promising is that of sowing the legume seed in the stubble with a drill and following with a roller or cultipacker. By use of this method, the seed would be put into the ground better with less destruction to the stubble than would be the case if a horrow or disc harrow were used.

It would hardly be fair to say that the method of summer seeding of legumes in stubble is 100 per cent perfect; yet, in view of the fact that it has proved successful four years in succession on the very light soil of northern Michigan, the least one could say is that it is well worth trying on soils which are easily shifted by wind or on those which do not hold enough moisture to supply a seeding and a nurse crop at the same time.

SPRAYING MATERIALS RECOMMENDED FOR 1929

Experience in Michigan Proves That Care Is Needed In Choice of Sprays

W. C. DUTTON, HORTICULTURAL SECTION

Though there are a number of spray materials which may be considered as standard and at least fairly satisfactory for the control of insects and diseases, new materials and variations in treatment are frequently offered for the growers consideration. Furthermore, there is more or less change in the amount of injury done by pests which require attention. The purpose of this article is to state briefly certain facts about some of the materials that are most likely to be used.

Oil Sprays—The use of oil sprays has become rather popular because these materials are somewhat less obnoxious to the one doing the spraying than certain other materials for which they are substituted and because they are thought to be effective against a rather large number of insects. It has been assumed also that the oils are rela-

tively safe from the standpoint of injury to plants. Evidence as to their effectiveness and safety has been gradually accumulated, and, though there is much yet to be learned about the use of oil sprays, it is possible to make a number of definite recommendations.

Oil sprays are recommended for specific purposes on tree fruits but their use is not advised for other than those purposes.

Pear psylla, fruit-tree leaf-roller, and orchard mites seem to be controlled best with oil. Scale insects can be controlled with either oil or lime-sulphur. However, the use of oil in the delayed-dormant period, that is, after green-tips have appeared, is not advised nor are oils recommended for aphid control on apples. The use of oils, then, should be confined to the dormant period and the exact time in that period will depend on the kind of insect or insects to be controlled. Specific recommendations will be found in the spraying calendar.

Summer Oils—Considerable experimental work has been done with the so-called "summer oils" for the control of pear psylla. Evidence now available indicates that sometimes an application of a "summer oil" may be a desirable supplement to the dormant treatment for the control of pear psylla. There is, however, a wide range in the safety of the different kinds or brands of summer emulsions, and caution should be exercised when choosing such a material. The preparation known as "Volck" seems to be the safest of the prepared materials that have been tested by the Michigan Experiment Station. Apparently, there is less likelihood of injury from mid- or late-summer applications than from applications made soon after the blooming period.

Dry-Mix Sulphur-Lime and Wettable Sulphur—These materials were introduced primarily as peach sprays but have been sold and used extensively for the control of scab on pears and apples. The results obtained from experimental work with these sprays and results attending their commercial use which have been observed by growers indicate definitely that materials of this type cannot be depended on for satisfactory scab control with all varieties or under epidemic conditions. Furthermore, they are relatively expensive and hard to handle and their principal merit seems to lie in the fact that injury to foliage and fruit is unlikely to follow their use. Sulphur pastes, precipitated sulphur, and colloidal sulphurs should be considered in the same class unless they are proven by later tests to be more effective. Sulfocide is a proprietary sulphur preparation that has failed to give satisfactory control of scab under severe conditions. Severe injury is likely to follow the use of this material in combination with lead arsenate unless special precautions are observed.

Calcium Arsenate—Calcium arsenate has been used to a limited extent by fruit growers as a substitute for arsenate of lead but the evidence at hand now is not such as to warrant recommending it for general use.

Dry Lime-Sulphur—Liquid lime-sulphur has been generally used for the control of apple scab but satisfactory results may be expected from the use of dry lime-sulphur provided it is used in proper proportions. In general, four pounds of the dry material are necessary to

equal one gallon of the liquid concentrate. The standard recommendation for liquid lime-sulphur is to use two and one-half gallons of the concentrate with water enough to make 100 gallons of spray; therefore, on the basis of a four to one ratio, 10 pounds of the dry lime-sulphur to 100 gallons of water would be required to give fungicidal efficiency, equal to the standard liquid. Though it is often possible to obtain satisfactory results with somewhat lower concentrations of both the liquid and the dry material, there is always the same relation as to comparative effectiveness.

Aphid Control—There are several species of aphids which may appear on the apple in the early spring. The treatment that is recommended as most likely to be successful is an application in the delayed dormant, or at the latest in the pre-pink, stage of lime-sulphur, two and one-half gallons, nicotine sulphate, one pint, and enough water to make 100 gallons of spray material. The lime-sulphur may be increased to 12½ gallons to 100 in the delayed dormant if scale insects are also to be controlled. Oils or other materials are not advised at this period.

Derrisol—Derrisol is a material rather new in this country. It is a contact insecticide which is offered for use in the control of several of the sucking insects. Its use is not advised for the control of pear psylla or for the delayed-dormant or pre-pink treatment of apple aphids. It does, however, seem to have merit for the control of summer infestations of the green apple aphid.

AUTOMATIC CONTROL SIMPLIFIES VENTILATION

Successful Venilation Depends Largely Upon Proper Control of Intakes

H. H. MUSSELMAN, AGRICULTURAL ENGINEERING SECTION

Ventilation is the process of keeping a building supplied with proper air for breathing. To maintain health in man or animal, a certain amount of fresh air is necessary. To provide for bodily comfort, a certain amount of heat is also necessary for both man and animals in northern climates, especially in the colder seasons of the year. Man uses artificial heat, and the protection of buildings is given animals to conserve their natural or body heat.

A building is usually considered to be warm when it is tight and well-insulated from loss of heat. Though desirable conditions of temperature may be secured in this way, the movement of air through the room is necessary to provide the desired degree of air purity. The air may become laden with moisture and intermixed with the exhaled

air and odors from the animal unless air circulation is provided. Though exhaled air may not be poisonous, a large amount of it in a room reduces the amount of fresh air available for breathing. However, if too great freedom of air movement through a room is permitted, sudden changes of wind velocity and temperature will make corresponding changes within the room, removing heat and producing unsatisfactory temperatures.

The purpose of ventilation is, then, to maintain a certain purity of air without disturbing too seriously the temperatures produced by artificial or body heat.

If forced ventilation is left out of consideration, the velocity of the wind and the "chimney" effect of warm air rising in a tight and well-

Ventilation Control

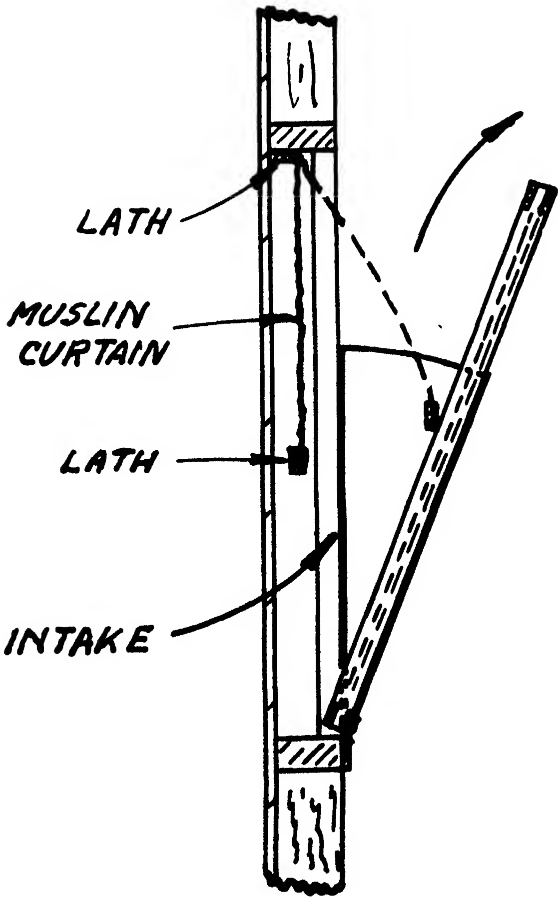


Fig. 1.—A muslin curtain for intake control is hung outside bottom hinged window. High wind velocity reduces size of intake opening.

insulated flue are relied on to produce changes of air in the room to be ventilated. The energy of the velocity of wind is used to produce movement of air in the out-take flue by allowing it to blow past specially constructed cupolas or tops in which is produces an aspiratory or suction effect and draws the air through the flue. It appears that the value of using wind velocity to create air movement through the room has been somewhat over-estimated. Fluctuations in wind velocity

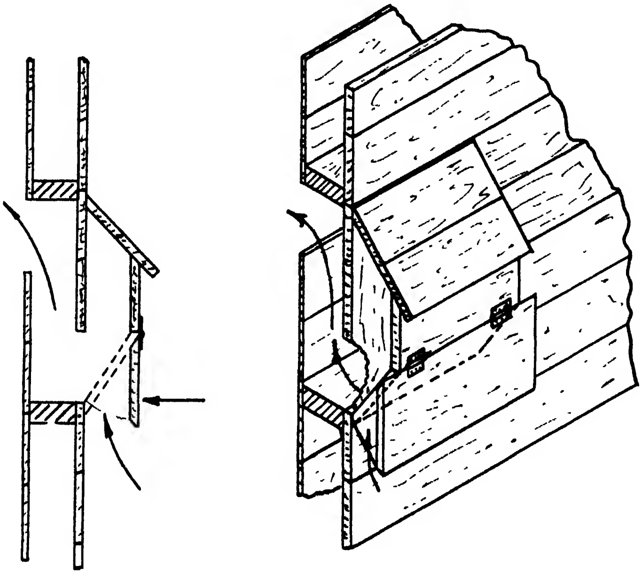


Fig. 2.—Wall intake opening with baffle board closed by wind pressure. This valve automatically controls flow of air through intake.

are a serious disadvantage because in periods of calm no air movement in the flue is produced by the wind; and, in periods of high wind velocity, when leakage of air around doors and windows would create enough changes of air, the action of wind velocity in drawing air from the room is too effective.

The usual arrangement of ventilating systems consists of large out-take flues, tight and well-insulated, made to extend above the high point of the roof. A larger number of smaller flues bring the air into the room. Intake flues are designed to reduce the velocity of the air as it passes through them. Both intake and out-take flues may have control valves which are hand-operated, or, in more recent designs, automatic valves and anti-back-draft valves which close when the air velocity through them is too high. Automatic valves may also control an excessive flow of air in either direction through the intake passages. It is desirable to have a ventilation system as nearly automatic as possible. The operators do not give hand controlled systems the necessary attention because they do not understand them or because they do not see immediate or visible results from such operation.

Suggestions for Control

Following are a few suggestions on securing better control of ventilators. The out-take flue should have a valve convenient for hand operation. This will be used to adjust air flow to meet violent changes to low temperatures or high wind velocities and low temperatures. So long as the top of the flue is protected from the weather, the use of a special ventilator top is not necessary.

For intakes, it is a great advantage to use windows. The type which are hinged at the bottom, have side cheeks, and swing into the room are satisfactory. When open, they deflect the air upward and prevent drafts. The addition of a muslin curtain outside the sash closes the air opening when wind velocity becomes too high, thereby automatically controlling the flow. Another type of wall intake opening using the same principle is shown in Figure 2. The passage of air is beneath the baffle board through the opening in the siding and upwards between the studding and into the room through the side wall. The outside opening is lower than the inner opening and reduces the air velocity. The baffle board swings inward with a high wind also cutting down the air movement into the building.

Considerable importance may be attached to intake controls. With out-takes few in number and equipped with valves, their control for extreme weather is easy. It is also evident that no more air will leave the room than comes in. If the intakes are effectively and automatically controlled, then little attention need to given any part of the system. Also, since wind pressure against the outside of the barn tends to increase air movement through the barn, then baffle intakes to be effective must be used on all sides of the room or building.

SUPPLEMENT CULL BEANS WITH ANIMAL PROTEIN

Tankage Fed to Hogs Produces More Rapid and Less Costly Gains

W. E. J. EDWARDS AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

When climatic conditions are unfavorable for maturing and harvesting the navy bean crop in this state, large quantities of cull beans are available for hog feed. During seasons when the supply is large, this feed can usually be purchased at a low price in comparison to the costs of other feeds. Any plan that will enable the hog feeder to more efficiently utilize cull beans as the major portion of the ration would therefore be of considerable value.

During the winters of 1926 and 1927, this Station conducted two experiments in feeding cooked cull navy beans with different propor-

tions of ground yellow corn to fattening fall pigs. Each group of pigs also had access to a mineral mixture and alfalfa hay.

The results of these two experiments indicated that something which was not supplied by either cull beans or yellow corn, was required by the pigs. These feeds did not produce satisfactory gains in any lot when 50 per cent or more of the ration consisted of cull beans. In fact, slow gains resulted when the ration consisted of one-third cull beans and two-thirds ear corn. When approximately the same proportions of cull beans were fed with ground corn, the gains were fairly satisfactory.

Another experiment was conducted at this station during the winter of 1928 to compare the feeding value of cull navy beans when fed with each of the following feeds: ground yellow corn, ground barley, and ground oats. As the addition of some animal protein usually improves a ration, even though there is a sufficient quantity of plant protein present, tankage was added to the ration for one lot of hogs which

Table 1.—Results of cull bean feeding experiment—1928.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Eight pigs in lot	Ground corn, tankage, minerals, alf. hay	Cull beans, 2 pts., gr. corn 1 pt., trough fed, minerals, alf. hay	Cull beans, 2 pts., gr. corn 1 pt., trough fed, tankage, minerals, alf. hay	Cull beans, 2 pts., gr. bar. 1 pt., trough fed, minerals, alf. hay	Cull beans, 2 pts., gr. bar. 1 pt., trough fed, tankage, minerals, alf. hay	Cull beans, 2 pts., gr. oats 1 pt., trough fed, minerals, alf. hay
Feeding period	Feb. 17 to April 12	Feb. 17 to May 11	Feb. 17 to April 28	Feb. 17 to May 13	Feb. 17 to May 4	Feb. 17 to May 11
Av. initial weight (lbs.)	106 87	109 12	106 25	108 00	108 00	108 12
Av. final weight (lbs.)	201 00	201 37	202 12	195 37	204 62	201 00
Av. daily gain per pig (lbs.)	1 711	1 098	1 350	1 007	1 255	1 106
Av. daily feed consumed (lbs.):						
Cull navy beans (lbs.)	..	3 479	3 498	3 209	3 291	3 106
Ground corn (lbs.)	5 986	1 863	1 886	...	.	...
Ground barley (lbs)	....	....	....	1 718	1 761	.....
Ground oats (lbs.)	....	.....	...	....	.. ..	1.674
Tankage (lbs.)	543	....	.204	.... .	.294	.....
Minerals (lbs.)	.005	.016	.012	.012	.011	.025
Alfalfa hay (lbs.)	.268	088	.088	.087	096	.083
Total, minus alf. hay (lbs.)	6 534	5.358	5 600	4.939	5 357	4.805
Feed required for 100 lbs. gain:						
Cull navy beans (lbs.)	......	316.80	259.06	318 60	262 22	280.89
Ground corn (lbs.)	349 80	169.65	139.64	....	.. ..	....
Ground barley (lbs.)	.. ..	....	. ...	170 57	140 36	....
Ground oats (lbs.)	....	....	.. ....	....	.. ....	151.41
Tankage (lbs.)	31 74	....	15.12	. ..	23.42	...
Minerals (lbs.)	.265	1 490	.912	1 171	.906	2 288
Alfalfa hay (lbs.)	15 67	7 99	6 52	8 64	7.63	7 587
Total, minus alf. hay (lbs.)	381 80	487.94	414.73	490.34	426 91	434 59
Feed cost for 100 lbs. gain:						
Cull navy beans at $25 ton	....	$3 96	$3 24	$3 98	$3 28	$3.51
Ground corn at $1.75 cwt	$6 12	2 97	2 44	....	....	....
Ground barley at $1.75 cwt	....	....	....	2.99	2.46	....
Ground oats at $1.75 cwt	....	....	....	....	....	2.65
Tankage at $75 ton	1 19	....	57	....	.88	.. ..
Minerals at $30 ton	.01	.02	.01	.02	.01	.03
Alfalfa hay at $12 ton	.09	.05	.04	.05	.05	.05
Total	7.41	7.00	6.30	7.04	6.68	6.24

were fed cull beans and ground corn, and to the ration for another lot which were fed cull beans and ground barley.

The Feeds Used and Methods of Feeding

Lot 1 (check) was self-fed ground corn and tankage.

Lot 2 received two parts cull navy beans and one part ground corn, trough fed.

Lot 3 was trough fed two parts cull navy beans and one part ground corn, with tankage self-fed.

Lot 4 was given two parts of cull navy beans and one part ground barley, trough fed.

Lot 5 received the same ration as did Lot 4, with the addition of tankage, self-fed.

Lot 6 was trough fed two parts cull navy beans and one part ground oats.

No. 2 yellow corn and 60 per cent tankage were used in these rations and each group of pigs had access to a mineral mixture in a self-feeder. Alfalfa hay was fed each group at fairly regular intervals. The mineral mixture used was composed of 45 pounds feeding bone meal, 20 pounds pulverized limestone and 30 pounds common salt.

The cull beans were boiled until they were fairly soft. They were then mixed, while hot, with the ground grain for the respective lots. Lot 1 was watered in a trough. The other lots were given what was considered sufficient water mixed with their feed.

Summary

1. Ground corn and tankage produced much larger daily gains and required considerably less feed for 100 pounds of gain than did any other feed combination used. The high cost of corn and tankage, however, made the gains produced by these feed the most expensive.

2. The addition of tankage to cull navy beans and ground corn increased the average daily gains .252 pounds, lowered the feed required for 100 pounds of gain 15 per cent, and reduced the cost of gains $0.70 per hundred weight.

3. The addition of tankage to cull navy beans and ground barley increased the average daily gains .248 pounds, lowered the feed required for 100 pounds of gain 13 per cent, and reduced the cost of gains $0.36 per hundred weight.

4. Ground corn, cull navy beans, and tankage produced .095 pounds more average daily gains, required 3 per cent less feed for 100 pounds of gain, and made the gains for $0.38 per cwt. less than did ground barley, cull navy beans, and tankage.

5. Cull navy beans when fed with ground corn, ground barley or ground oats produced practically the same daily gains. The feed requirements for 100 pounds of gain when ground corn was fed was practically the same as when ground barley was fed, but was 12 per cent higher than when ground oats were used. The feed cost for 100 pounds of gain where corn was fed was $0.04 lower than where barley was fed, but $0.76 per hundred weight higher than in the lot which was fed oats.

Although cull navy beans have a high protein content, this protein is relatively low in feeding value. The addition of tankage, which is an animal protein, brought about a big improvement in the quality of protein in the ration. This was shown by increased gains and lower cost of production in both cases where this supplement was used.

FOREST RESERVE TAX LAWS ARE NOT PERFECT

Reduction in Cutting Tax Would Increase Acres in Forest Reserve

KARL DRESSEL, FORESTRY SECTION

In 1925, the Pearson bill to provide for the establishment of commercial forest reserves and for their administration and taxation was passed by the legislature and became Act 94 of the Public Acts of 1925. The act is often referred to as the Pearson Timberland Tax Act or the Commercial Forest Reserve Act. It was amended by Act 356 of the Public Acts of 1927.

A commercial forest reserve, within the meaning of the act, is a tract of land from which the mature forest has been removed and which contains no natural resources other than forest growth. Such land must be capable of producing a thrifty forest, and, at the time of listing, must actually carry sufficient forest growth of suitable character to give reasonable assurance that a stand of merchantable timber will be developed in the near future.

The owner of such lands, in order to take advantage of the act, must file an application with the State Department of Conservation. Upon receipt of the application, the Department of Conservation determines the character of the land offered and sets a date for a public hearing upon the eligibility of such land for listing. The public hearing must be held in the county where the land is located. A notice of such hearing and a list of the descriptions to be considered for classification as commercial forest reserves must be published in a local newspaper.

Any owner desiring to withdraw lands listed as a commercial forest reserve must pay a fee of five cents per acre for each year the land has been registered. If the land has been classified under the act for more than 15 years, the owner must pay an additional fee of 10 cents per acre per year in excess of 15 years. In case the land has been classified for more than 25 years and the owner wishes to withdraw it, he must pay a fee equivalent to 30 per cent of the full stumpage value.

The owner of land registered as a commercial forest reserve is entitled to a permit to cut forest products on the land without with-

drawing it from classification. The permit is issued by the Department of Conservation under certain rules and regulations.

Taxes Paid

Under this act, the owner pays 10 cents per acre per year to the local government and a yield tax of 25 per cent of the stumpage value of the timber when cut. The State also pays the local government 10 cents per acre per year for all lands listed under the act. The 25 per cent cutting tax is paid at the time of harvest and one-half goes to the State and one-half to the local government. Matters pertaining to the act are administered by the State Conservation Department.

The Forestry Department of the Michigan State College has been co-operating with the Forest Taxation Inquiry of the United States Forest Service in a study of the act. It has found that the owners of 86,231 acres of land have applied for listing. Some of the applications were rejected for various reasons. The following table shows the number of acres listed and the reasons for rejections up to June 1, 1928:

Table I.—Lands listed and rejected under the Pearson Act.

County	Number of acres applied for under act	Number of acres accepted and listed under act	Number of acres rejected under act	Accepted not listed	Reasons for rejection						
					Too Sparse	Farm land	Mature timber	Resort property	Soil too valuable	State land	Mineral land
Alcona	960	120	840		520		240		80		
Allegan	1,200		1,200	1,200							
Antrim	260		260		260						
Barry	26	26									
Baraga	6,088	2,213	3,875	714	2,359			438	364		
Benzie	1,528	360	1,168		1,088	80					
Chippewa	1,040	760	280						280		
Cheboygan	5,041	2,280	2,761		2,641		40		80		
Charlevoix	1,248	1,165	83		40	23		20			
Clare	1,196		1,196		1,196						
Delta	5,724	2,204	3,520	1,120	1,760				640		
Dickinson	640	200	440	80	360						
Emmet	520	160	360		40	200	120				
Genesee	127		127					127			
Gladwin	160	80	80		80						
Houghton	11,353	9,622	1,731	1,320	320			91			
Iosco	2,207	920	1,287		1,247					40	
Iron	2,542		2,542	600	1,942						
Livingston	80	80									
Lake	860	820	40			40					
Luce	638	160	478		40		160	238		40	
Marquette	840	320	520	160	40		320				
Mackinac	363	201	162						162		
Menominee	9,091	7,771	1,320		1,000	200		120			
Missaukee	1,196		1,196	40	1,156						
Midland	160		160								160
Manistee	40	40									
Mason	2,070	590	1,480		1,480						
Newaygo	160	40	120		120						
Osceola	142		142		142						
Otsego	1,127	1,127									
Ottawa	160	160									
Ogemaw	1,532	1,052	480	120	200		120		40		
Ontonagon	11,129	1,813	9,316		200				9,116		
Presque Isle	160		160	160							
Sanilac	120		120		120						
Roscommon	12,423	5,529	6,894	40	6,694	160					
Schoolcraft	120	80	40				40				
Wexford	1,960	240	1,720	160	1,280	280					
Total	86,231	40,133	46,098	5,714	26,325	983	1,040	1,034	10,762	80	160

Number of Acres Listed

The table shows that owners of forest lands in 39 counties have applied for listing of 86,231 acres. Of this area 40,133 acres, or 46 per cent have been accepted. The forest growth was too sparse on 26,325 acres to assure a reasonable stand of timber in the near future as required under the act. The soil was found too valuable for forestry purposes on 10,762 acres, of which 9,116 acres were located in the rich Ontonagon valley. The Conservation Department accepted 5,714 acres which were afterwards withdrawn by the owners. The Conservation Department refused 1,040 acres because it was stocked with mature timber and as such is not eligible under the act. It was also found that 1,034 acres were more valuable for resort purposes, 983 acres were farm land, 160 acres were more valuable for oil, and 80 acres were already owned by the State and so were refused listings under the act.

Table II shows the taxes under the general property tax at the time of listing and also the new taxes under the Pearson timberland tax

Table II.—Lands applied for and listed under the Pearson Act.

County	Acres			Taxes			Owner's benefit under act	Township gain or loss under act
	Acres applied for under act	Acres accepted and listed under act	Acres rejected	Owner's tax under act	Township's total tax under act	General property tax		
Alcona	960	120	840	$12 00	$24 00	$23 24	$11 24	+$0 76
Allegan	1,200	....	1,200	....	....	....	....	....
Antrim	260	....	260	....	....	....	....	....
Barry	26	26	....	2 60	5 20	22 34	19 74	— 17 14
Baraga	6,088	2,213	3,875	221 30	442 60	583 64	362 34	—141 04
Benzie	1,528	360	1,168	36 00	72 00	145 66	109 66	— 73 66
Chippewa	1,040	760	280	76 00	152 00	239 15	163 15	— 87 15
Cheboygan	5,041	2,280	2,761	228 00	456 00	785 67	557 67	—320 67
Charlevoix	1,248	1,165	83	116 50	233 00	570 32	453 82	—337 32
Clare	1,196	....	1,196	....	....	....	....	....
Delta	5,724	2,204	3,520	220 40	440 80	489 00	268 60	— 48 20
Dickinson	640	200	440	20 00	40 00	36 64	16 64	+ 3 36
Emmet	520	160	360	16 00	32 00	43 93	27 93	— 11 93
Genesee	127	....	127	....	....	....	....	....
Gladwin	160	80	80	8 00	16 00	16 68	8 68	— 68
Houghton	11,353	9,622	1,731	962 20	1,924 40	2,536 41	1,574 21	—612 01
Iosco	2,207	920	1,287	92 00	184 00	108 59	16 59	+ 75 41
Iron	2,542	....	2,542	....	....	....	....	....
Livingston	80	80	....	8 00	16 00	35 34	27 34	— 19 34
Lake	860	820	40	82 00	164 00	158 02	76 02	+ 5 98
Luce	638	160	478	16 00	32 00	21 64	5 64	+ 10 36
Marquette	840	320	520	32 00	64 00	79 04	47 04	— 15 04
Mackinac	363	201	162	20 10	40 20	72 70	52 60	— 32 50
Menominee	9,091	7,771	1,320	777 10	1,554 20	9,997 11	220 01	+557 09
Missaukee	1,196	....	1,196	....	....	....	....	....
Midland	160	....	160	....	....	....	....	....
Manistee	40	40	....	4 00	8 00	21 60	17 60	— 13 60
Mason	2,070	590	1,480	59 00	118 00	100 65	41 65	+ 17 35
Newaygo	160	40	120	4 00	8 00	14 59	10 59	— 6 59
Osceola	142	....	142	....	....	....	....	....
Otsego	1,127	1,127	....	112 70	225 40	307 30	194 60	— 81 90
Ottawa	160	160	....	16 00	32 00	43 40	27 40	— 11 40
Ogemaw	1,532	1,052	480	105 20	210 40	210 26	95 06	+ 14
Ontonagon	11,129	1,813	9,316	181 30	362 60	618 69	437 39	—256 09
Presque Isle	160	....	160	....	....	....	....	....
Roscommon	12,423	5,529	6,894	552 90	1,105 80	644 08	91 18	+461 72
Sanilac	120	....	120	....	....	....	....	....
Schoolcraft	120	80	40	8 00	16 00	10 66	2 66	+ 5 34
Wexford	1,960	240	1,720	24 00	48 00	88 02	64 02	— 40 02
Total	86,231	40,133	46,098	$4,013 30	$8,026 60	$9,038 96	$5,111 66	+1,137 51 —2,126 28

act. It shows the present benefit to the forest land owner and the loss or gain to the local governments under the act. The plus signs indicate a gain in revenue over the general property tax and the minus signs indicate a loss. The table disregards the 25 per cent cutting tax collected at the time of harvest as no cutting taxes have yet been paid.

In some cases, the local government is receiving more revenue from listed forest land each year than they did under the general property tax, and, in addition to this, they will receive half of the cutting tax when the timber is harvested. This is the case in Alcona, Dickinson, Iosco, Lake, Luce, Menominee, Mason, Ogemaw, Roscommon, and Schoolcraft Counties. It would be so for all lands listed if they paid less than 20 cents per acre per year under the general property tax. The annual losses at the present time place no great burden upon the local government.

The timber on the lands listed under the Pearson timberland tax act ranges from very small immature trees to those almost ready to harvest. For a basis of comparison over a considerable period of years, the forest growth under this act was assumed to have an average age of 20 years. A rotation of 70 years is needed to produce good hardwood logs on a fair quality of site. An acre should produce 10,000 board feet of timber probably worth at least $20 per 1,000 board feet 50 years from now. As the average age of the stands under the act was assumed to be 20 years, the tax rotation would be 50 years.

Tax Methods Compared

Under the Pearson act 40,133 acres have been listed. The total taxes payable per year on these lands under the general property tax at the time of listing was $9,038.96 or 22 cents per acre. If this tax remained constant for 50 years the total amount paid would be $451,948 or $11.26 per acre. The lands being listed under the Pearson act the owners pay a land tax of $4,013.30 per year or an average of 10 cents per acre. The State pays an equal amount to the counties. The tax remaining constant, the owners would pay in the course of 50 years a total of $200,665, or an average of $5.00 per acre, and the State would pay the same. At the end of 50 years, the timber should be cut and the owners would pay the cutting tax of 25 per cent. If the timber runs 10,000 board feet to the acre worth $20 per 1,000, it would have a total value of $8,026,600 or an average value of $200 per acre. The cutting tax would be $2,006,650 in all or an average of $50 per acre. This cutting tax would be equally divided between the county and the State. The owners would pay, therefore, under the Pearson act the sum of the land tax and the cutting tax, a total of $2,207,315 or an average of $55 per acre as against a total of $451,948 or $11.26 per acre under the general property tax.

The above calculation does not provide for an increase in the general property tax as the timber gets older. If it is assumed that the average merchantable stand of hardwoods is assessed at $60 per acre and that the tax rate is $30 per $1,000 of value, the general property tax would be $1.80 per acre. If it is further assumed that the average tax on very young stands is 20 cents per acre, and that the taxes in-

crease uniformly each year for the 50 years up to $1.80 per acre, then the total taxes paid under the general property tax would be $50 per acre. This is about the same as the total of the taxes under the general property tax. It is much higher than existing taxes because properties are not reassessed each year. It is a maximum.

The Pearson timberland tax act has reduced the average annual yearly tax burden of the owners of these listed timber lands and has thus helped reduce the tax over the non revenue producing years. The local government on the average has not suffered under the Pearson timberland tax act as the annual payments from both the land owner and the State have about equalled the revenue taken in under the general property tax. The cutting tax of 25 per cent is much too high and takes too great a portion of the total revenue from the landowners.

The cutting tax and land tax together, figured on present assessment values and tax rates, would take more than the general property tax. The cutting tax could be reduced at least one-half. With a reduced cutting tax, the act should prove a relief measure for owners of forest land by placing the heavy tax burden at the time the income is received.

CORN-BORER PREFERS CORN TO COMMON MUGWORT

Control Measure Suggested by French Scientist Not Practical

A. R. MARSTON, FARM CROPS SECTION, AND C. B. DIBBLE, ENTOMOLOGICAL SECTION

The European corn borer (*Pyrausta nubilalis*) attacks corn in the presence of common mugwort* (*Artemisia vulgaris*) to the same extent as it does when mugwort is not present. This was demonstrated this year by an experiment conducted at the Michigan State College Corn Borer Experiment Station at Monroe, Michigan.

Late last season wide publication was given to the theory that the corn-borer preferred common mugwort to corn, and that the borer might be controlled by the planting of mugwort in corn fields, thus attracting the borer away from the corn to the supposedly preferred host-plant.

*Common mugwort (*Artemisia vulgaris*) is a native of Europe but has been transferred to North America where it is found in scattered localities in the Eastern part of the Continent. It is commonly known as a weed.

This theory developed from the finding of Dr. E. Raubaud**, in France, who stated, "In the neighborhood of Paris it is the common mugwort which keeps the corn borer in a latent state * * * *. The Mugwort is more suitable than corn for the development of the corn borer * * * *."

The experiments at Monroe were planned to determine whether Dr. Roubaud's finding would apply to conditions in Michigan. Corn was planted with common mugwort, in the open and also under cages. In the cages, infestation was forced by putting a large number of moths in the cage and giving them the preference of either host on which to deposit their eggs.

During the period of moth flight, egg counts were made on the plants of corn and on those of mugwort, and later the mature plants were dissected and the number and location of borers determined. In each case the plantings were made in three rows, with the mugwort occupying the center row so that it was influenced on either side by the corn.

The following tables indicate the number of plants subjected to the open (natural) and the forced (caged) conditions.

Table I.—The corn borer attack on mugwort compared to corn planted in the open under natural conditions.

Host	Number of plants	Number of corn borer eggs	Number of corn borers	Number of points of attack
Corn	80	50	23	17
Mugwort (Artemisia vulgaris)	37	0	3	3

The results as shown in Table No. I indicate that the corn borer, under natural conditions, prefers corn to mugwort. A few borers and a few points of attack were found on the mugwort, and as there had been no eggs deposited on the mugwort, we are led to believe that the borers found were borers that had migrated from the corn either voluntarily or by being blown by the wind. This would be similar to field conditions, where corn borers migrate to other pithy stemmed weeds in corn fields.

Table No. II shows the infestation under artificial conditions, where moths were placed in the cage and forced to lay their eggs either on the corn or the mugwort, and the young borers to feed either upon the corn or the mugwort. In Cage No. 1, the situation more closely approached natural conditions than in Cage No. 2, that is, there were more borers on the corn than on the mugwort. No eggs were deposited on the mugwort in either cage. In Cage No. 2, an equal number of borers were found on the mugwort and the corn but this possibly can be accounted for. The corn under Cage No. 2 was not as hardy and did not produce

**International Corn Borer Investigations. Scientific Reports. E. Roubaud on the Host Preference of the Corn-Borer. Importance of the Common Mugwort as a Preferred Detracting Plant for the Protection of Crops. By E. Roubaud: Comptes rendus des seances de L'Academie des sciences. Vol. 185, p. 1158.

Table II.—The comparative corn borer attack on mugwort and corn planted under cages where artificial infestation was forced by introducing corn borer moths.

Host	Number of plants	Number of corn borer eggs	Number of corn borers	Number of points of attack
Cage No. 1:				
Corn	14	184	24	48
Mugwort (Artemisia vulgaris)	22	0	6	14
Cage No. 2:				
Corn	14	60	22	24
Mugwort (Artemisia vulgaris)	12	0	23	23

as large a stalk as in Cage No. 1, thus not supplying the borers with sufficient material to work on. The significant fact is that the corn in both cages, in the presence of mugwort, was totally destroyed by the corn borer.

Conclusions

1. The corn borer prefers corn to common mugwort as a host plant.
2. Corn, in the presence of mugwort, is not protected by the latter from corn borer attack.

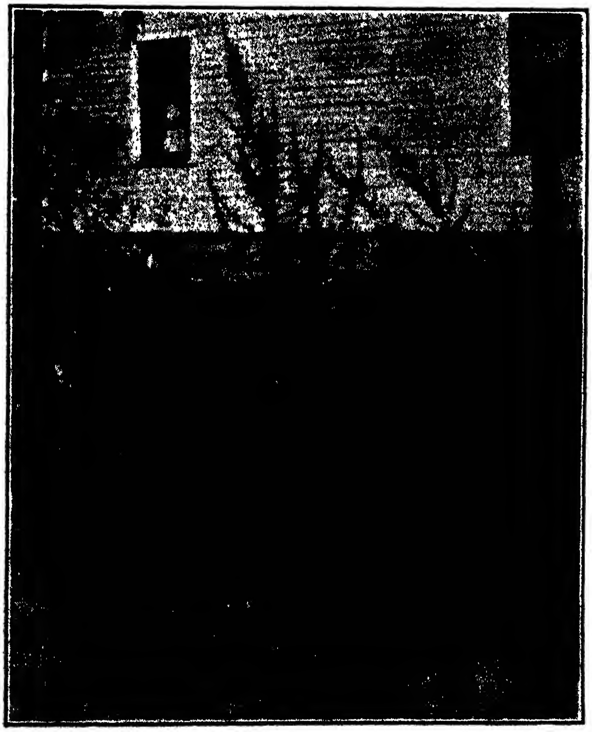


Fig. 1.—Common Mugwort.

3. A migration of the corn borer from corn to mugwort is possible after the eggs have been deposited on the corn but the migration does not indicate a preference on the part of the corn borer for common mugwort as a host.

The authors beg to acknowledge the courtesy of the Botany Department, Central Experimental Farm, Ottawa, Ontario, Canada, who kindly furnished the seed of mugwort (*Artemisia vulgaris*) which was used in this work.

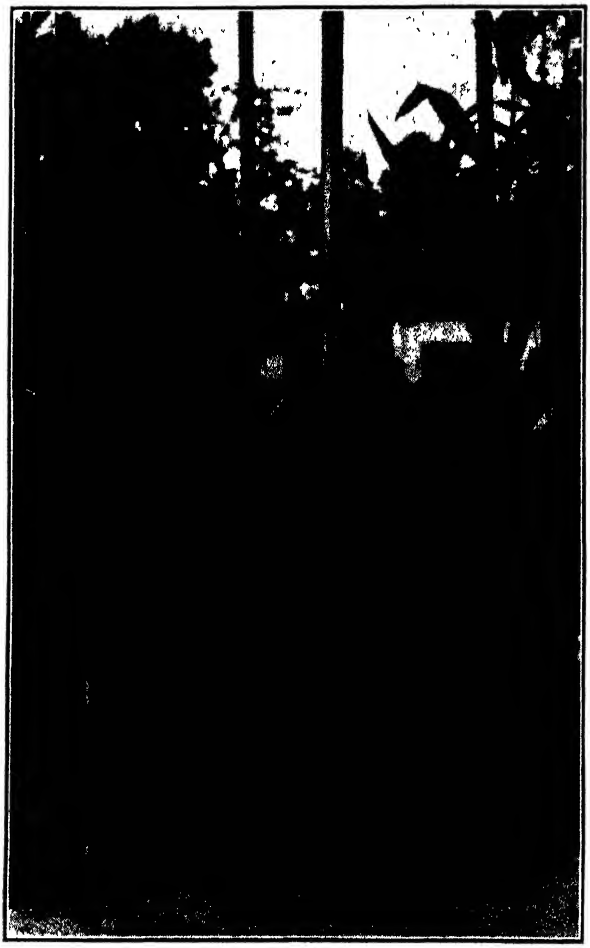


Fig. 2.—Corn—Mugwort—Corn under cage.

HARDIGAN ALFALFA LEADS IN VARIETY TESTS

Southern Seed Makes Poor Showing on State Experimental Plots

H. C. KIEBLER, FARM CROPS SECTION

A tabulation of the results of the over-state tests of alfalfa shows that Hardigan alfalfa is the leading variety for the production of hay in Michigan. The tests were made to determine the comparative values of northern and southern grown seed under characteristic Michigan conditions.

The test plots have been planted for from one to four years and are a co-operative project of the county agricultural agents, local growers, and the crops department of Michigan State College. The plots are located in Huron, Branch, Jackson, Livingston, and Arenac counties so that the effects of soil and weather variations can be detected.

The alfalfa varieties tested were certified Michigan Grimm and Hardigan, Cossack, Ontario Variegated, and northern common from Michigan, South Dakota, Utah, and Idaho. The seed of the southern varieties which were tested came from Argentine and Arizona. The varieties in each plot were planted at the same time and received similar car after planting. All the seed was inoculated and planted in a well prepared seed bed. Ten to twelve pounds of seed per acre was sown and each test plot was a drill width wide and from 20 to 30 rods long.

The yields secured from the first cutting in 1928 are as follows:

Livingston County

Farm of Homer Wasson, Gregory

Planted 1924 Variety	Sandy Loan Soil *Yield
Hardigan	2.77 tons per acre
Cossack	2.62 tons per acre
Michigan common	2.33 tons per acre
Michigan Grimm	2.29 tons per acre
South Dakota common	2.24 tons per acre
Utah common	1.20 tons per acre
Argentine	0.19 tons per acre

*Air dry hay, calculated from green weight.

Jackson County

Farm of O. R. Kintigh, Mosherville

Planted 1924 Variety	Sandy Loan Soil *Yield
Hardigan	1.91 tons per acre
Cossack	1.73 tons per acre
Michigan Grimm	1.71 tons per acre
South Dakota common	1.57 tons per acre
Michigan common	1.42 tons per acre
Utah common	1.42 tons per acre
Argentine	0.68 tons per acre

Branch County

Farm of D. T. Bascom, Montgomery

Planted 1925 Variety	Sandy Loan Soil *Yield
Hardigan	2.55 tons per acre
Michigan Grimm	2.00 tons per acre
Utah common	1.51 tons per acre
Argentine	1.45 tons per acre

Arenac County

Farm of Ed. Donahue, Sterling

Planted 1927 Variety	Sandy Loan Soil *Yield
Michigan Grimm	1.70 tons per acre
Hardigan	1.64 tons per acre
Michigan common	1.50 tons per acre
Ontario Variegated	1.42 tons per acre
Cossack	0.93 tons per acre
Argentine	0.46 tons per acre
Arizona common	0.00 tons per acre

Huron County

Farm of Alfred Sturm, Pigeon

Planted 1927 Variety	Clay Loam Soil *Yield
Michigan common	2.33 tons per acre
Michigan Grimm	2.29 tons per acre
Ontario Variegated	2.16 tons per acre
Hardigan	2.06 tons per acre

*Air dry hay, calculated from green weight.

Note: The trial on Mr. Sturm's farm was also harvested for seed with the Hardigan having the largest yield.

In looking over these results, we find Hardigan out-yielding the other varieties in the majority of the plots, with Grimm, Cossack, Michigan common, and Ontario Variegated following in order.

In each case where the Hardigan did not lead, the plots were but one year old and at this age several varieties such as Grimm, Cossack, Michigan common, or Ontario Variegated may equal the Hardigan.

After three or four years, Hardigan outyields the other varieties by a substantial margin and shows practically no sign of winter killing and has but a slight trace of June grass or other weeds. The thickness of the old Hardigan stands is practically the same as for the first year or two. This variety is also very prolific in its blossoming habits, which tends to increase its seed producing ability.

With less hardy varieties, winter killing has begun to show its hand, the stand is thinner, June grass and other weeds have crept in, and, as a result, the yield is greatly reduced. This is especially true with the southern grown seed, Argentine and Arizona common. In almost every case, seed from those regions is practically all winter killed after the first year or two.

These tests are showing that success with alfalfa in Michigan is dependent upon the planting of northern grown, winter hardy seed. Seed from warm regions is not at all suited to this climate. The tests give further evidence of the outstanding hardiness of Michigan grown seed, especially of varieties like Hardigan alfalfa. Such varieties promise to aid materially in the establishing of a Michigan alfalfa seed industry.

BUILDING IMPLEMENT SHED IS GOOD ECONOMY

Painting and Greasing Do Not Give Farm Tools Adequate Protection From Weather

F. E. FOGLE, AGRICULTURAL ENGINEERING SECTION

Farm machines which are not housed and properly cared for depreciate rapidly. When less machinery was used, extra space in the barn or other buildings was sufficient to house it. The tractor, automobile, truck, binder, haying machinery, and other larger and expensive equipment must be housed to prevent rapid deterioration. Such machines will, in the majority of cases, require a special building.

Very often statements are made to the effect that, if machines are painted as often as necessary and are properly greased, the loss due to weathering will be less than the cost to maintain an implement shed. This argument might be valid in the case of too expensive a building; but practical farmers are quite generally agreed that housing machinery is profitable since machines last longer, require less attention before being used, are more efficient, and have better appearance. The essential requirements of an implement shed are that it keep off storms and sun, afford convenience in storing machines, and provide sufficient space. A building to meet these requirements may be of very simple design for the use of lower grades of lumber or of metal.

Location For Shed

The implement shed should be so located as to be readily accessible from the horse barn and the fields. In case a part of the shed is utilized as a garage or shop, a location closer to the house than to the barns is desirable.

The width of the shed should be determined by the kind and size of machinery to be housed. A width of 18 feet is satisfactory for most farm machinery. The length may be made to accommodate the amount of machinery to be housed. A height of nine feet will house any farm machinery with the exception of a hay loader and possibly the truck. Continuous doors hung on parallel tracks are most satisfactory and convenient.

The plans as shown in Figures 1, 2 and 3 have been carefully worked out to make construction economical, simple, and strong. If desired a part or all of the shed may have an open front. In this case, the shed open to the east gives best results.

To fill the needs of those who require a larger building we can furnish plan C-2026. This plan is for a shed 28 feet wide and any length desired. This width will accommodate a wagon including tongue. Furthermore machinery may be run in from either side since it is so designed that continuous doors may be used on each side.

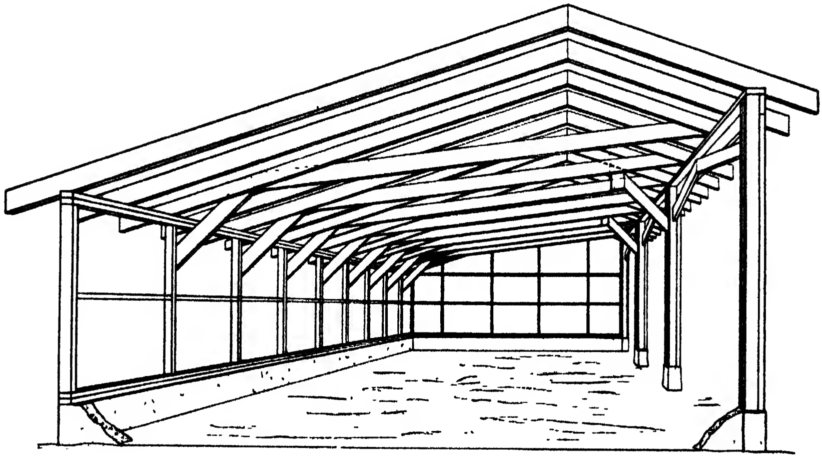


Fig. 1.—An interior perspective showing details of construction. The frame may be adapted to horizontal siding by omitting the girt and placing studding two feet center to center.

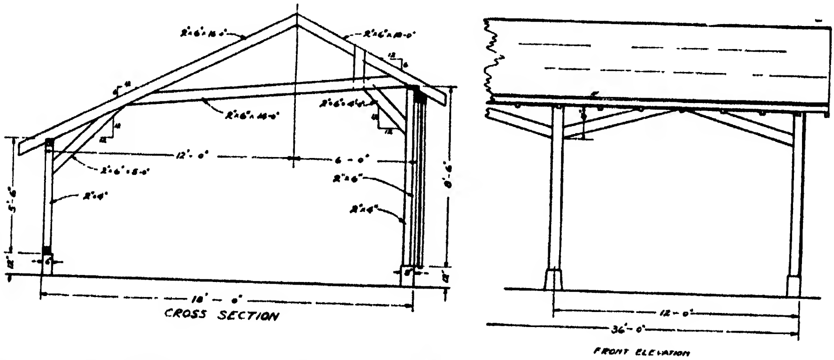


Fig. 2.—Showing the truss which is placed every four feet, also the method of bracing the front.

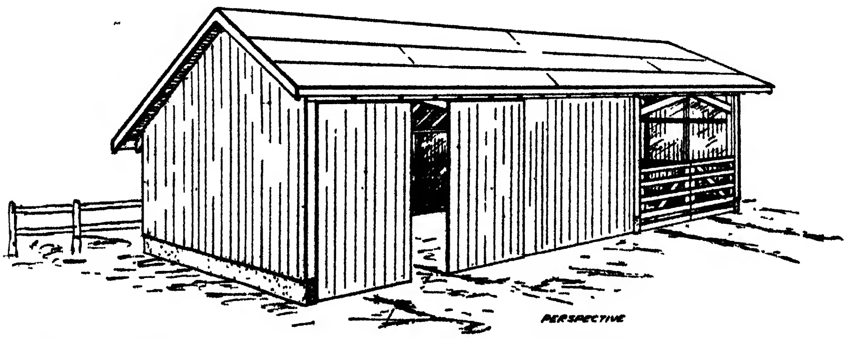


Fig. 3.—Exterior perspective emphasizing option of open front or doors.

BUD SPORTS OF DECIDUOUS FRUITS STUDIED

Trials Indicate That Worthwhile Variations Can Be Perpetuated by Vegetative Reproduction

B. D. DRAIN, HORTICULTURAL SECTION

For many years, there has been much discussior of the bud-selection question. Much of this discussion has been based on theoretical considerations. The desirability of a careful, comprehensive field study, supplemented by propagation tests is obvious. Such a study was begun by the Horticultural Department of the Michigan Experiment Station a number of years ago. During the last several years, the study has been greatly aided by the co-operation of Mr. Roy Gibson of the Greening Nursery Company of Monroe, who, through long intimate acquaintance with literally thousands of commercial fruit plantations in Michigan, has had exceptional opportunities to note the occurrence of bud sports.

As a part of this study, an attempt has been made to locate as many bud sports or alleged bud sports as possible. Each one has been marked, carefully described, revisited a number of times to check on the permanency of its characteristics, and photographs and other suitable records have been made. Such historical data as were available have been obtained.

Whenever possible, cions were taken from the sport and from the parent form. The resulting trees or top grafts are being grown under conditions which put to the test the degree to which the supposed sport propagates true. In a few cases, data have been obtained on the results of such propagation tests, which were begun some years earlier by the owners of the sporting forms. The investigation is only nicely begun and it will be a number of years before it will be possible to issue a final report.

Nevertheless, the records that are available warrant the following statements that will be of interest to fruit growers: Bud sports of deciduous fruits are of fairly common occurrence; and, in this study, over 100 such sports have already been located and described and are being put to propagation tests.

Types of Variation

Among the more interesting and important types of sporting that have been noted are: russet-fruited varieties of apples, pears and crab-apples; color variations, from the striped to solid color form or vice versa, in apples, pears, plums, and cherries; late or early ripening forms of cherries and peaches; large fruited or giant forms of apples; semi-barren or unproductive forms; variations in shape of fruit; and variations in length of internode, size of leaves, and the general growth habit and other vegetative characteristics of trees.

Cions from some of these sports, which show variations in season of maturity, productivity, and in color markings, have been growing long enough to demonstrate that they transmit these characteristics when propagated vegetatively. Thus a late-ripening and at the same time shy-producing strain of the South Haven peach which originated as a bud sport on the grounds of the South Haven experimental substation has been propagated vegetatively and has "bred" true in this test. Similarly, there are a number of bearing trees of a russet-fruited Bartlett pear that were propagated by a grower from a bud sport on one of his trees. To what extent the many other sports that are under propagation test will similarly "breed" true cannot be foretold.

A few of these sports would be classed horticulturally as superior to the parent forms from which they have sprung. A larger number would be classed as inferior or degenerate forms. From both the academic and the practical standpoints, the one group is as interesting and as important as the other. Though exact data are not available as to the relative frequency of bud sports in deciduous fruits or as to the percentage of trees that are likely to constitute departures from type when no special attention is given to the matter in the cutting of cions, the evidence indicates that the question is of some practical as well as academic interest.

Fruit growers who have noticed what appear to be bud sports in their orchards, whether of an apparently desirable or an undesirable type, are urged to bring them to the attention of the Horticultural Department of the Michigan Experiment Station, that they may be examined and studied in connection with this investigation.

DISINFECTANTS RETARD BACTERIA IN INCUBATORS

Experiment Shows Bacteria Count Greatly Reduced by Thorough Cleaning and Disinfecting

J. L. BOYD, POULTRY SECTION

This experiment was conducted to determine the extent of bacterial growth and development in uncleaned, cleaned, and disinfected incubators. The results of work done at the Kansas Experiment Station indicate that incubators may be a means of dissemination of pathogenic organisms.

To determine the relative number of bacteria present in disinfected incubators at Michigan State College, four sections of a Newtown incubator were thoroughly cleaned with warm water and washing powder and disinfected with commercial disinfectants in solutions of the strength recommended by the manufacturers. The eggs placed in

the four sections were also sprayed with the disinfectant used in that section. The fifth section was used as a control or check, and was thoroughly cleaned but no disinfectant was used on incubator or eggs. The sixth section, which was used as a second control or check, was left uncleaned from a previous hatch and no disinfectant was used.

The incubator used was a Newtown sectional machine. Each of six compartments contained 140 eggs. Temperature, moisture, and ventilation were therefore similar for all six sections and were maintained as uniform as possible throughout the 21 day incubation period.

Plates of liver agar were exposed for periods of time noted in tabulations given later. Bacterial counts and identification were made by Professor Mallmann and Dr. Thorpe of the Bacteriology Section of this Station. The excellent service and co-operation rendered by these men was of great importance in this experiment.

The most prevalent types of bacteria found in incubators were those usually classed as soil organisms. Bacteria found and identified were *Bacillus subtilis, Bacillus mycoides, Bacillus mesentericus,* and numerous chromogenic cocci.

The method of procedure was as follows:

Section number	Number of eggs set	Treatment of eggs	Treatment of incubator	Disinfecting solution used
1	140	Sprayed	Cleaned and sprayed	*Sterilac
2	140	Sprayed	Cleaned and sprayed	**Sodium hypochlorite
3	140	Sprayed	Cleaned and sprayed	†Iodine suspensoid.
4	140	Sprayed	Cleaned and sprayed	‡Chlorinated lime.
5	140	None	Cleaned, not sprayed	None.
6	140	None	Not cleaned or sprayed	None.

*One teaspoonful to a gallon of water.
**3% solution.
†1 part suspenseid to 19 of water.
‡5 ounces per gallon of water.

The actual count of colonies of bacteria on various days of the 21 day hatching period was as follows:

SECOND DAY OF INCUBATION

Group number	Plate number	Time exposed	Disinfectant solution used	Number of colonies	Molds present
1	1	½ min.	Sterilac	3	No.
2	2	½ min.	Sodium hypochlorite	0	No.
3	3	½ min.	Iodine Suspensoid	1	No.
4	4	½ min.	Chlorinated lime	1	No.
5	5	½ min.	None—Clean incubator	1	No.
6	19	½ min.	None—Dirty incubator	2	No.
1	7	1 min.	Sterilac	0	No.
2	8	1 min.	Sodium hypochlorite	0	No.
3	9	1 min.	Iodine suspensoid	1	No.
4	10	1 min.	Chlorinated lime	0	No.
5	11	1 min.	None—Clean incubator	0	No.
6	21	1 min.	None—Dirty incubator	6	No.
1	13	10 min.	Sterilac	0	No.
2	14	10 min	Sodium hypochlorite	1	No.
3	15	10 min.	Iodine suspensoid	1	No.
4	16	10 min.	Chlorinated lime	0	No.
5	17	10 min.	Check—Clean incubator	0	No.
6	26	10 min.	Check—Dirty incubator	17	No.

ELEVENTH DAY OF INCUBATION

Group number	Plate number	Time exposed	Disinfectant solution used	Number of colonies	Molds present
1	30	10 min.	Sterilac	0	No.
2	31	10 min.	Sodium hypochlorite	0	No.
3	32	10 min.	Iodine suspensoid	4	No.
4	33	10 min	Chlorinated Lime	11	Yes.
5	34	10 min.	None—Clean incubator	0	No.
6	48	10 min.	NoneD—irty incubator	40	No.
1	36	20 min.	Sterilac	6	Yes.
2	37	20 min.	Sodium hypochlorite	4	Yes.
3	38	20 min.	Iodine suspensoid	3	Yes.
4	39	20 min.	Chlorinated lime	1	Yes.
5	40	20 min.	None—Clean incubator	10	No.
6	49	20 min.	None—Dirty incubator	317	No.

TWENTIETH DAY OF INCUBATION

Group number	Plate number	Time exposed	Disinfectant solution used	Number of colonies	Molds present
1	65	10 min.	Sterilac	3	No.
2	66	10 min.	Sodium hypochlorite	5	Yes.
3	67	10 min	Iodine suspensoid	2	No.
4	68	10 min.	Chlorinated lime	10	No.
5	69	10 min.	None—Clean incubator	17	No.
6	84	10 min.	None—Dirty incubator	154	No.
1	71	20 min.	Sterilac	12	No.
2	72	20 min.	Sodium hypochlorite	1	Yes.
3	73	20 min.	Iodine suspensoid	3	No.
4	74	20 min.	Chlorinated lime	13	No.
5	75	20 min.	None—Clean incubator	66	No.
6	85	20 min.	None—Dirty incubator	181	No.
1	77	30 min.	Sterilac	5	Yes.
2	78	30 min.	Sodium hypochlorite	5	Yes.
3	79	30 min.	Iodine suspensoid	8	No.
4	80	30 min.	Chlorinated lime	66	Yes.
5	81	30 min.	None—Clean incubator	55	No.
6	86	30 min	None—Dirty incubator	129	No.

TWENTY-FIRST DAY OF INCUBATION

Group number	Plate number	Time exposed	Disinfectant solution used	Number of colonies	Molds present
1	87	10 min.	Sterilac	16	No.
2	88	10 min.	Sodium hypochlorite	6	Yes.
3	89	10 min.	Iodine suspensoid	6	No.
4	90	10 min.	Chlorinated lime	317	No.
5	91	10 min.	Check—Clean incubator	87	No.
6	106	10 min.	Check—Dirty incubator	119	No.
1	93	20 min.	Sterilac	29	Yes.
2	94	20 min.	Sodium hypochlorite	14	No.
3	95	20 min.	Iodine suspensoid	14	No.
4	96	20 min.	Chlorinated lime	395	No.
5	97	20 min.	Check—Clean incubator	101	No.
6	107	20 min.	Check—Dirty incubator	121	No.
1	99	30 min.	Sterilac	43	Yes.
2	100	30 min.	Sodium hypochlorite	9	No.
3	101	30 min.	Iodine suspensoid	19	No.
4	102	30 min.	Chlorinated lime	284	No.
5	103	30 min.	Check—Clean incubator	51	No.
6	108	30 min.	Check—Dirty incubator	198	No.

The total count of colonies of bacteria for each group during the entire experiment was as follows:

Group number	Disinfectant used	Total colonies of bacteria	Per cent of total count	Number of plates showing mold
1	Sterilac	117	4	4
2	Sodium hypochlorite	45	1 5	5
3	Iodine suspensoid	62	2 0	1
4	Chlorinated lime	1,098	36.7	3
5	Check—Clean incubator	388	12 9	0
6	Check—Dirty incubator	1,284	42 9	0
Total		2,994	100 0	

A survey of the total bacterial count shows a fairly equal total of colonies for each of the disinfectants with the exception of chlorinated lime. The chlorinated lime solution gave approximately as low a count as other disinfectants until the 20th day of incubation. On the 15th day, the turning apparatus of the incubator broke several eggs in the chlorinated lime group. The egg material evidently furnished a very desirable medium for bacterial growth. The gain in count of bacterial colonies between the 20th and 21st days of incubation was enormous in this chlorinated lime group. Much of this rapid gain was undoubtedly due to the egg material on the unbroken eggs furnishing a good medium for bacteria, and the count increased by the movement of the chicks hatching which kept bacteria constantly in the air. The air movement caused by the hatching chicks was favorable for heavy bacteriological seeding of the exposed agar plates.

The bacteria count under group 5 in the section of the incubator which was thoroughly cleaned but not treated with any disinfectant showed a decidedly lower count than group 6 in the uncleaned and untreated section. If we take group 6 which was the untreated and uncleaned section as having 100 per cent bacterial contamination some relative idea of the effectiveness of disinfectants may be gained. The figures on group 4 treated with chlorinated lime of course will be misleading due to the accidental conditions involved. The relative percentages follow:

Group	Disinfectant used	Relative per cent bacterial count
1	Sterilac	9.1
2	Sodium hypochlorite	3.5
3	Iodine suspensoid	4.8
4	Chlorinated lime	85.5
5	Check—Clean incubator	30.2
6	Check—Unclean incubator	100.0

The results of relative percentages reveal that sections which were thoroughly cleaned and disinfected and in which the hatching eggs were sprayed show a relative count of less than 10 per cent. This of course

does not include group 4 with the broken eggs. Section 5 which was thoroughly cleaned showed a bacterial count of 70 per cent less than the uncleaned section No. 6.

Conditions affecting the presence of the molds are difficult to explain in this case and would require much additional work before any definite conclusions might be drawn. Very few molds were found present, and this in itself is perhaps of much more significance than the fact that no molds appeared in the control plates.

All eggs used in this experiment were produced by hens which the agglutination test showed to be free of bacillary white diarrhea, although special efforts were made to isolate the organisms associated with this disease.

Total count of bacteria for the various days of incubation were as follows:

Day of incubation of eggs	Total count of colonies
2	34
11	396
20	735
21	1,829

Conclusions

1. Thorough cleaning of incubators was the greatest factor in reducing bacterial count.

2. Use of disinfectants further reduced the bacterial count to below 5 per cent in all but the chlorinated lime section in which eggs were accidentally broken.

3. Bacterial infection of exposed agar plates increased as the period of incubation progressed.

4. The greatest bacterial count was at hatching time, and was perhaps caused by movement of chicks keeping bacteria constantly in the air.

5. Broken eggs furnish a favorable medium for bacterial development.

6. While incubators may be cleaned and disinfected until practically sterile, the room air passing through the incubator ventilators carries air borne organisms into the machine. This tended to increase the bacteria count as the incubation period progressed.

7. Eggs from bloodtested breeding stock were used, and although no pathogenic bacteria were found, the marked reduction in the bacterial count would indicate that cleaning and disinfecting is of material value in lessening incubator transmitted diseases.

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting an Orchard.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to libraries and teachers).
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
80 Yellow Rocket (a dangerous weed).
82 Durability of Concrete Drain Tile No. 11.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
104 Soils of Detroit Area.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
109 Dependable Michigan Crop Varieties.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
122 Improvement of the Farm Woodlot.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.

129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
136 The Muck Soils of Michigan.
137 Marketing Michigan Potatoes.
138 Rural Highways.
139 Tourist Camps.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
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174 Spraying Calendar.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it upon the receipt of ten cents (coin or stamps).

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The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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Graham Station, Kent Co., 50 acres donated by R. D. Graham; 50 acres purchased. H. M. Wells, Supt.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

ISSUED DURING
FEBRUARY, MAY, AUGUST,
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EDITED BY
V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN

Vol. 11, No. 3, February, 1929

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NOTICE

Mailing List Revision

The mailing list for this bulletin will be revised. If you wish to receive the Quarterly Bulletin of Michigan State College Experiment Station, fill out the return card and mail it to the Director of the Experiment Station, East Lansing, Michigan.

The Bulletin contains reports of research work done at the Michigan Station and articles about new practices which have been tested by members of the College staff. An attempt is made to print articles which have a timely interest.

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EFFECT OF FLUORINE IN DAIRY CATTLE RATION

Experimental Evidence Indicates Fluorine Content of Raw Rock Phosphate is the Detrimental Factor

BY GEORGE E. TAYLOR, DAIRY SECTION

Raw rock phosphate and steamed bone meal are mineral supplements of very similar composition. Both are composed largely of tricalcium phosphate, $CA_3(PO_4)_2$, along with certain impurities. Steamed bone meal is an animal product or organic substance. Raw rock phosphate is an inorganic material mined from the soil. Both have been recommended in the past as a suitable mineral supplement for dairy cattle.

If they were of equal value as a source of calcium and phosphorous in the ration, there would be a considerable economic advantage in using raw rock phosphate. Steamed bone meal sells for about $50.00 a ton, while raw rock phosphate can be purchased at as low a figure as $10.00 a ton. Results of experimental work completed at Michigan State College, however, indicate that raw rock phosphate has a very detrimental effect on the health of dairy animals when used as a mineral supplement.

During a 20-day trial, raw rock phosphate was included at the rate of three per cent in the grain mixture in the ration of dairy cattle. This amount proved to be injurious to their health and the ration was refused after the second day. When forced to consume this ration, further digestive disturbances were produced. Both the hay and silage consumption were decreased and the grain ration was either refused or eaten sparingly. Their appetites remained poor, resulting in a considerable loss of flesh. At the close of the 20-day period the animals were gaunt, the coat of hair was roughened and considerable irritability was noticeable.

Effect of Five Years' Feeding

Other animals fed for a period of five years on a basal ration containing one and one-half per cent raw rock phosphate serve as further evidence to prove that raw rock phosphate is detrimental to the health of dairy cattle. These animals were placed on the experiment at three months of age. From then up until the time of the first lactation period, there was apparently no marked detrimental effect caused by the feeding of raw rock phosphate. When, however, the grain allowance was increased to meet the animals' requirements for milk production, the results were different. Their appetites were first affected. The heifers failed to consume a normal amount of roughage and later a portion of their grain allowance. Their coats became rough-

ened and eventually the entire group presented a markedly emaciated condition. In time, they began to lap and drink water with considerable hesitancy, particularly during the winter months when the water was cold. This led to an examination of their teeth in an effort to determine the cause. Their teeth showed very abnormal development. Step formations along with other abnormalities were found, and the molars, particularly, were worn down in many cases until the grinding surface was practically obliterated. This had exposed the nerves until the teeth were rendered sensitive to cold water.

Apparently, some impurity in the raw rock phosphate was responsible for these results. Raw rock phosphate is known to contain from 1.8 per cent to 4.88 per cent fluorine depending upon the source of the

Fig. 1.—Condition after six months of fluorine feeding. Animal F-1.

phosphate rock. The raw rock phosphate used in experimental work at this station contained about three per cent fluorine. According to McCollum, Simmons, and Becker, a ration containing not more than 0.0266 per cent fluorine on a dry matter basis stunted the growth of rats and caused their incisors to increase in size and to grow in abnormal positions. These two facts led to the supposition that the fluorine content of raw rock phosphate might be the detrimental factor. As a result, the present experiment was outlined as a branch of the long time mineral feeding experiments.

Numerous animals in this experiment have been fed varying amounts of fluorine in the form of calcium fluo silicate, CaF_6 SiO_2 $2H_2O$. Fluorine has been fed in this form because of two reasons: first, fluorine is readily soluble in this combination; and second, the fluorine in raw rock phosphate may be combined with the silicates.

Animals Refuse Feed

The first two animals placed on the experiment were started on July 27, 1926. The fluorine was first fed at two different levels. The ration of animal F-1 consisted of 0.125 per cent fluorine on the dry matter basis. In the ration of the second animal, C-16, the fluorine was doubled. Fluorine fed at these levels proved very detrimental. The results were identical in the case of both animals. They at once went off feed and refused to eat either their roughage or grain mixture in any appreciable amounts for a period of three weeks.

On August 17, 1926, animal C-16 was removed from this phase of the experiment, and fluorine in the ration of animal F-1 was reduced to 0.4 gram daily. The entire ration was then eaten with relish. The fluorine content of the ration was gradually increased until five grams of calcium fluo silicate was being fed daily. Since December 10, 1926, the fluorine content of her ration has been equal to the amount of fluorine consumed daily by animals fed raw rock phosphate as a mineral supplement at the rate of 1.5 per cent in the grain mixture. Animal F-1 is still receiving fluorine as calcium fluo silicate. Prior to her first lactation period, which began on August 21, 1927, she remained apparently normal in health and general appearance as shown in Fig. I. She suffered slight digestive disturbances and went off feed occasionally for very short periods of time prior to freshening.

After freshening, this animal began to lose flesh rapidly and showed a general loss of appetite. Her hair became rough, and, toward the end of the first lactation period, she was emaciated and in poor condition. This condition parallels almost identically the history of the animals fed on raw rock phosphate as a mineral supplement. Animal F-1 started lapping water for the first time during the months of June and July, 1928. The teeth at this time were observed to be rather narrow and the cow was slightly shear mouthed. She stopped lapping for a time but began again after her second freshening, September 6, 1928. During the latter part of December, 1928, and up to the present time, she has lapped water continuously. While her teeth do not show marked abnormalities, the grinding surfaces of the molars have been worn down sufficiently to render the teeth sensitive to cold water. This last condition, as previously noted in this article, developed in animals fed on raw rock phosphate as a mineral supplement.

Trials With Other Animals

January 12, 1928, at the age of four months, animals F-4 and F-5 were started on a basal ration consisting of skim milk, corn and oats, alfalfa hay, and 50 grams of steamed bone meal daily. F-5 was used as a check animal, and 1.5 gram of calcium fluo silicate was added to ration of F-4. The latter refused the usual allowance of corn and oats, after the second day. This calf rapidly showed a loss of condition and thrift, her coat of hair became rough, and considerable irritability was noticeable. The appetite of F-5 remained good and the calf developed normally in all respects. At ten months of age, skim milk feeding was discontinued and the two calves were changed to the same basal ration plus 50 grams of bone flour daily. Calcium fluo silicate feeding at the rate of 1.5 grams daily was continued in case of animal F-4. The con-

dition of this animal gradually grew worse until August 4, 1928, when the fluorine in the ration of the two animals was switched. While the condition of F-4 at once showed marked improvement following the change, F-5 was suddenly thrown off feed. It became necessary to reduce the daily allowance of roughage in order to induce the animal to consume a normal amount of grain. At present, F-5 is in general poor flesh and presents a very apparent run down condition.

Animals F-6 and F-7 were added to the fluorine group on February 10, 1928. These calves have been fed in exactly the same manner as outlined for F-4 and F-5. Animal F-7 receives the fluorine ration. The

Fig. 2.—Showing condition after 25 months of fluorine feeding at the same level as fluorine content of Raw Rock Phosphate. Animal F-1.

rations, however, have not been changed on these two animals. At present, F-6 is normal in all respects but F-7 shows the characteristic emaciated and run down condition. These two animals will be continued and observations noted regarding their general health and condition. The development of their teeth will also be studied.

Another group has just been added which is to receive the same basal ration. In this group, however, fluorine in the form of sodium fluoride is to be used instead of fluorine as calcium fluo silicate.

Summary

The results show that fluorine is detrimental to health and general condition of dairy animals when fed at the same level as the fluorine content of raw rock phosphate. The results indicate that fluorine interferes with normal development of the teeth of dairy animals when fed at the same level as stated above.

INSECTS AID FRUIT SETTING OF RASPBERRY

Many Undeveloped Blossoms Found When Insects Are Excluded from Plants

BY STANLEY JOHNSTON, HORTICULTURAL SECTION

During the blossoming season of 1927, an experiment was started to determine the influence of insects, particularly the honey bee, on the fruit setting of red and black raspberries. Four large plants of Cuthbert and the same number of Cumberland plants were enclosed in two cages made of window screen. These cages were put in place just before the blossoms opened. An equal number of similar plants were marked outside of the cages. The weather during the blossoming season was satisfactory for insect activity, and large numbers of bees were at work on the raspberry blossoms.

The cages were removed soon after the blossoming period had passed and a record was made of the number of flowers that had failed to set fruit and the number of perfect and imperfect berries on representative fruiting shoots growing on plants that had been inside the cages. Similar records were obtained from the plants growing outside of the cages. The data are presented in the accompanying table.

Table 1.—The influence of pollination by insects on fruit setting in raspberries

Variety	Number fruiting shoots	Total number blossoms	Number blossoms failing to set fruit	Per cent blossoms failing to set fruit	Total number berries	Number imperfect berries	Per cent imperfect berries
Cuthbert:							
Inside of cage	25	487	354	72.6	133	57	42.9
Outside of cage	25	431	147	34.1	284	8	2.8
Cumberland:							
Inside of cage	22	182	18	9.8	164	36	21.9
Outside of cage	22	176			176	3	1.7

A much smaller percentage of the flowers set and developed fruit, and the percentage of imperfect or defective berries was much higher on plants from which bees had been excluded during the blossoming season than on plants open to insect pollination. This held for both Cuthbert and Cumberland, though the Cumberland seemed able to set and mature a larger percentage of its blossoms without the aid of insect carriers than Cuthbert.

Percentage of Undeveloped Blossoms

Seventy-two per cent of the Cuthbert blossoms inside of the cage were abortive, while only 34 per cent of the blossoms outside of the cage were abortive. Likewise, 43 per cent of the Cuthbert berries inside of the cage were not perfectly formed, while only three per cent of the berries outside of the cage were imperfect. Apparently, Cumberland has a greater degree of self-fertility than Cuthbert for only 10 per cent of its blossoms inside of the cage aborted and there were no abortive blossoms on the plants outside of the cage. Only 22 per cent of the Cumberland berries inside of the cage were imperfect compared to 43 per cent for Cuthbert.

It is evident that benefits to be derived from suitable provision for pollen transfer, both in increased production and to some extent in perfection of fruit, are such that bees should be placed in or near the raspberry plantation during the blossoming season.

The first (counting from left to right) and the third are typical clusters of Cumberland raspberries from plants outside the cage where the flowers were open to insect pollenation. The second and fourth clusters are typical of plants enclosed in the screen wire cage during blossoming to exclude pollen carrying insects.

DUNBAR STATION STUDIES FORESTRY PRACTICES

Coniferous Seedlings Distributed at Cost for Forest Plantings
Progress Report—Dunbar Forest Experiment Station

BY PUTNAM ROBBINS, FORESTRY SECTION

The Dunbar Forest Experiment Station, Michigan State College's experimental tract in Chippewa County, is located sixteen miles south of Sault Ste. Marie on the west bank of the St. Marys River opposite Neebish Island. The tract of land comprising 577 acres was given to Michigan State College in 1925 by Chippewa County and Mr. H. T. Dunbar of Buffalo, New York.

The Dunbar Station forest lands are divided into experimental and demonstration tracts each yielding approximately an equal supply of timber annually. The demonstration forest is being developed to show the returns that can be obtained from a forest of the type prevalent in this region, when managed under the best known present day silvicultural systems.

When the Station was acquired in 1925, there were 120 acres of farm lands. Since 1925, 70 acres of the farm lands which were run-out and unfit for agricultural crops have been planted to trees. The remaining area consists of virgin forests and cut-over lands with some natural forest cover.

Types of Land in Tract

The forest lands are of three general types: first, a mixed stand of white spruce, balsam fir, and white pine; second, a hardwood type consisting of more or less mature broadleaf trees native to this region; third, a softwood-hardwood mixture with an abundance of advance reproduction of spruce, balsam, and poplar.

The Dunbar Station cooperates with the Federal Government under the Clarke-McNary law to produce forest tree seedlings for sale at cost for forest and windbreak planting. The forest nursery at the Dunbar Station was started in 1925 to supply the Upper Peninsula of Michigan with forest tree seedlings which are grown in and adapted to that region. Nursery stock produced at the Dunbar nursery is better adapted to planting in the Upper Peninsula because there is no advanced growth at the time the stock is to be shipped for field planting. The shipping distance from the Dunbar nursery to all points in the Upper Peninsula is much shorter than the distances from Lower Michigan nurseries, and. therefore, the stock spends less time in transit and arrives in better condition for planting. Nursery stock can be more successfully shipped from a cold to a warmer region than from a warm to a colder region.

The first shipment of seedlings from the nursery was made during the spring of 1928. Over 25,000 seedlings were shipped and 30,000

more were lifted for forest planting on the Station lands. The species grown at the Dunbar nursery are White pine, Norway pine, Scotch pine, White spruce, and Norway spruce. No hardwood seedlings are grown at this nursery. The stock available for shipment in the spring of 1929 includes White pine, Scotch pine, White spruce, and Norway spruce. Forest tree seedlings from this nursery are not sold for ornamental planting or for resale.

Experimental Work Conducted

Experiments in nursery practice are being carried on each year to determine the best methods of nursery culture for the locality. Mulching experimnts with a number of different mate..als to determine the best method of protecting seed beds from winter injury, and the treatment of seed beds with chemicals to prevent damping-off, a serious nursery disease, are being tried out. Animal and mineral fertilizers are being experimented with to determine the best fertilizer for the sandy loam soils. Plans for 1929 call for the installation of a Skinner overhead sprinkling system. The water supply system has already been installed. The forest lands are divided into compartments and subcompartments according to the silvicultural systems which are to be applied to them.

Pulpwood Is Main Product

The principal product of the Dunbar forest is and will be spruce and balsam pulpwood, for which there is a steady demand and an accessible market. The pulpwood which the Station delivers on its water front, the bank of the St. Marys River, bring $5 to $9 per cord. The thinnings conducted in the hardwood type will for the present furnish the Station with fuelwood. Hardwood saw logs will not be removed until the quality of the hardwood forests has been improved.

Twenty acres of the hardwood forest in the St. Marys River block have been gone over with an improvement cutting which removed all the diseased and defective trees. Approximately 60 cords of fuelwood were removed in the operations. Eleven acres of hardwood-softwood type received an improvement cutting during October and November, 1928. This cutting opened up the area and, at the same time, cleaned out the undesirable trees. All dead and down timber unfit for fuelwood was piled and burned along with the slash. This area borders the Charlotte River and the thinning has greatly increased the beauty of the road into the Station and now affords views of the river from the road. The volume of timber removed from this area was approximately 20 cords of pulpwood and 10 cords of fuelwood.

Selective logging operations were started during the fall of 1928 in the spruce and balsam forests. The operations removed the mature spruce down to a diameter limit of 10 inches and the balsam down to a diameter limit of eight inches. The diameter limits were used more or less flexibly in order to thin crowded stands and leave the area uniformly stocked. Over 60 cords of pulpwood were removed.

The operations also removed all paper birch and poplar on the area which were large enough for fuelwood. Over 18 cords of fuelwood were removed. Dead tamarack, many of which have been killed off

in this region by the attacks of the larch sawfly, were also removed for fuelwood.

All the slash from the selective logging operations was piled and burned as the cutting proceeded. The method of the felling and skidding operations prevented all unnecessary damage to the advanced reproduction on the area. The workmen aimed to leave the area in the best possible condition for continued growth and the production of pulpwood.

Fire Fighting Equipment Used

Nature has provided fire barriers at the Dunbar Station. The St. Marys River forms the east boundary of the lands and the Charlotte River runs through the forest lands from northwest to southeast. The Station is equipped with a portable Evinrude twin forest fire pump and five hundred feet of one and a half inch hose. This little pump can be carried by two men and is capable of delivering 27 gallons of water per minute at 90 pounds pressure through 500 feet of hose. A large part of the forest lands can be reached with water in case of fire by the use of this pump. The timber surrounding the forest nursery can be reached with water from the nursery water system where water is secured under pressure from a 1,000 gallon storage tank.

The fire protection system also includes a network of fire lines eight to 10 feet wide which have been constructed around each 40 acres of the forest lands. The fire lines make all portions of the timbered lands readily accessible in case of forest fire and provide lines from which fires may be fought. Back-pack tanks of five gallon capacity with hand pumps, hazel hoes, shovels, axes, saws, and lanterns complete the Station's fire fighting equipment.

Planting Operations

Experiments at the Dunbar forest are aiming at the regeneration by both natural and artificial means of forests on cut-over, worn out farm lands and on swampy areas.

In 1926, 20 acres of stump land were planted with white pine and fir seedlings. During 1927, 31 acres were planted, using 20,000 Norway pine, 5,000 Norway spruce, and 2,000 Scotch pine. The planting was done in plowed furrows. In the spring of 1928, 40 acres were planted. On this area, double disking and plowing were tried as means of preparing the site and checking weed growth. The fall planting in 1928 covered the replacement with transplant stock in spots where the previous year's seedlings had failed. The early spring and late fall moisture conditions have made it advisable to try spot planting in place of the plowed furrow method on portions of the old farm lands.

Sample plots have been laid out on areas containing seed trees and the soil exposed on adjacent areas to determine to what extent natural seeding will take place on mineral soil.

Growth studies of the white spruce, balsam fir, and hardwoods are under way. Sample plots have been laid out and will be measured every five years. Growth tables containing diameters and heights of white spruce and balsam fir from 10 to 60 years of age have been made.

TABLE MADE TO ESTIMATE SPRUCE AND BALSAM

Is Based on Limited Data But Will Be Useful in Northern Michigan

BY P. W. ROBBINS, FORESTRY SECTION

A knowledge of the contents of trees in cubic feet, board feet or cords is desirable when selling timber or in taking an inventory of the timber tract. There have been many cases where the owner has sold his timber for less than half its real value because he did not know the amount of timber he had. Estimating is the process of determining the number of board feet, cubic feet, or cords in a standing tree.

In order to furnish a basis for timber estimating, volume tables are used. These tables give the average contents of standing trees of various species by diameters and heights. They are intended to take the place of the old time timber estimator's knowledge of standing timber, by which he could look at a tree and estimate its contents.

Basis For Volume Table

A volume table for white spruce and balsam fir was constructed during the selective logging operations in 1928 at the Dunbar Forest Experiment Station in Chippewa County. The operation removed only trees eight inches and over in diameter. Balsam fir predominated on this area and since not enough white spruce were cut to warrant a separate table, both spruce and balsam fir were combined in one. This volume table may be too high or too low for some conditions found in the Upper Peninsula, because it is not based on a sufficient number of trees or enough area to be fully representative of all conditions. It is, however, the best one available at present.

The table is based on measurements of 143 felled trees. Each tree was measured outside the bark at 4½ feet above the ground, before it was felled. The stump diameter, stump height, and diameters every 8.1 feet up the tree trunk were taken as soon as the tree was cut into pulpwood lengths. The length from the last cut to the tip of the tree was also measured. Pulpwood sticks were cut to a top diameter limit of 3.5 inches. All diameter measurements were taken inside the bark with the exception of the one at breast height or 4.5 feet above the ground. From these measurements the volume of each eight foot stick was figured and the total volume of each tree obtained by adding the volumes of all eight foot sticks in it. When the last cut would not make an eight foot stick 3.5 inches in diameter at the small end, a four foot stick was made and its volume was figured.

An estimate of the cubic feet of pulpwood on a small tract of land, 10 acres or less, can be secured by measuring the diameter of all trees

on the area at 4.5 feet above the ground, estimating the heights of the trees, and using the following table to secure the volumes for each diameter class.

This table gives the average number of merchantable cubic feet of pulpwood in spruce and balsam trees of various sizes.

Volume table for spruce and balsam fir in cubic feet, for Northern Michigan

Diameter in inches at 4.5 feet above ground	Total height in feet 40-50	50-60	60-70
	Merchantable volume in cubic feet		
7	4.6	5.8	6 4
8	5 4	6.2	7 9
9	6 7	9 0	10 3
10	10 2	12 4	13 8
11	.	15 8	17 0
12	.	18 2	19.8
13	.	20 4	22 8
14		24 8	26 0
15		.....	29 6
16	.	.....	32 8
17	..	..	36 0

A standard cord of pulpwood measures 128 cubic feet. The cord of pulpwood as produced in the woods is a pile of eight foot wood four feet high and four feet long and it contains on the average 95 cubic feet of solid wood and 33 cubic feet of air space between the sticks. Estimates of standing pulpwood timber in cubic feet may be reduced to standard cords by dividing the total volume by 95.

In estimating pulpwood tracts greater than 10 acres in area, a tree-to-tree count is not practical and the quarter acre circle method may be used as outlined on page 19, "Improvement of the Farm Woodlot," Michigan State College Agricultural Experiment Station Special Bulletin No. 122.

OAT RUST DAMAGE SEVERE IN UPPER PENINSULA

Development of Immune Varieties of Oats Appears Promising

BY B. R. CHURCHILL, FARM CROPS SECTION

The average acreage of oats in Michigan during the past five years (1924-1928) has been 1,623,400. This is a greater acreage than is occupied by any other single crop, with the exception of tame hay.[1]

[1]Annual Crops Report for Michigan, 1924-'27, Monthly Crops Report for Michigan, October, 1928.

The average yield per acre for this five year period is 35.3 bushels. Michigan farmers have been able to produce oats of good quality as is indicated by their winnings at the International Grain and Hay Show at Chicago.

Although the annual production in the state is around 50,000,000 bushels, the demand is greater than the supply. Every year, oats are shipped into the state and sold for feeding purposes. For the past several years the acreage devoted to oats in the state has remained fairly constant. It seems likely that any increase in production will come as the result of higher yields.

Factors Influencing Oat Production

A number of factors influence the yield of oats. Among the more important are seed bed preparation, seed treatment for smut, use of fertilizers, and growing of recommended varieties. Farmers generally throughout the state are making use of these factors in producing the crop. Two factors, however, that have thus far been largely beyond the farmers' control are weather conditions and the damage caused by rust. The former is plainly an uncontrollable factor. Just what has been accomplished with the latter in an experimental way is the text of this article.

Damage Due to Rust

Rust can be found on oats in Michigan every year. Some years the damage is slight; in other years, it may be so serious that the crop is a failure. Throughout the Upper Peninsula of Michigan, in 1926 and 1927, the early part of the summer gave promise of a good oat crop. Later in the season, the rust epidemic came on and was so severe that fields that had given promise of at least a 50 bushel yield per acre, weighing at least 32 pounds to the bushel, actually yielded less than 20 bushels of oats which weighed less than 25 pounds to the bushel. Many fields were so poor that they were not threshed; some were not even harvested. During the same two years, rust was found on oats in the Lower Peninsula but the epidemic was not so severe.

Nature of Disease

Oats may be attacked by either black stem rust or crown rust. Investigation has shown that there are several forms of black stem rust[2] and likewise several forms of crown rust.[3] An oat plant may be affected with only black stem rust or with crown rust but it is quite possible to find both these rusts on the same plant. The stem rust is more common in the North; while the crown rust, though present in the North, seems to be most abundant and serious in the South.[4]

Both rusts produce, at a particular time in their development, a red dust of spores. It is these spores that are seen flying in the air and that settle on the binder at harvest time. These spores, unlike those

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[2]Stakman, E. C., Levine, M. N., and Bailey, D. L. 1923, Biologic forms of Puccinia Graminis on Varieties of Avenae spp. Jour. Agr. Res. Vol. 24. 6/24/23. No. 12.

[3]Melhus, I. E., Dietz, S. M., and Willey, F. 1922. Alternate Hosts and Biologic Specialization of Crown Rust in America. Ia. Agr. Exp. Sta. Res. Bul. 72.

[4]Parker, J. H. 1918. Greenhouse Experiments on the Rust Resistance of Oat Varieties. U. S. D. A. Bul. 629.

causing oats smut, are not carried over from one year to the next on the seed[5]; and, therefore, rust cannot be controlled by seed treatment.

Relation to Weather

Many people believe that the rust is caused by the weather. Weather does play an important part in its development and spread but the disease is caused by a parasitic fungus plant[6] and not by the weather. In the Upper Peninsula of Michigan, rust may be found on oats early in the summer, but, as a rule, the epidemic does not appear until the oats have headed out.

Rust spores germinate best under conditions of warm temperature and an abundance of moisture. Consequently, rust is favored by warm rainy or muggy weather about the time the oats are heading out. Under such conditions, the rust will spread rapidly and cause serious damage. Light drizzling rains are more favorable for rust development than are heavy dashing rains. The weather of the Upper Peninsula is characterized by the former. Cold wet weather, warm dry weather, or cold dry weather are not favorable to the germination of the rust spores; so, if such conditions prevail for a period of two weeks after oats have headed out, the rust, even though it is present, fails to become serious.

Control Measures

Rust, as a general rule, does its most serious damage late in the season. This fact suggests one method of combating the disease. Seeding early in the spring may enable the crop to mature sufficiently before the rust appears and thus escape serious damage. Early maturing varieties may be able to mature before serious rust attacks appear. This was quite strikingly shown in the oats varietal test plots of 1927 at the Upper Peninsula Experiment Station. An early maturing variety yielded 60 bushels per acre as compared with 31 for Wolverine, the Michigan standard variety. In years when rust was not severe, the reverse of this has been true.

The use of fertilizer also offers a means of fighting rust. At the Upper Peninsula Experiment Station, the application of super-phosphate at the rate of 150-200 pounds per acre at seeding time has hastened the maturity of the crop from seven to 10 days. In this way, the oats have, in some instances, matured sufficiently early to escape damage from rust. Nitrogenous fertilizers should be avoided because an excess of nitrogen stimulates stem and leaf growth and delays maturity.

The development of rust-resistant varieties as a means of combating the rust is perhaps more promising than any other method. Several experiment stations throughout the United States have been working along this line for several years.

Experimental Work at Chatham

For the past five years, the Upper Peninsula Experiment Station, cooperating with the United States Department of Agriculture, has grown several varieties of oats under close observation for rust in-

[5]Stakman, E. C. 1918. Black Stem Rust and the Barberry. U. S. D. A. Bul. 796.
[6]Stakman, E. C. 1918. Black Stem Rust and the Barberry. U. S. D. A. Bul. 796

fection. Seedings for each of the five years (1924-1928) consisted of a one-rod row of each variety. Rows were spaced one foot apart. Time of planting, time of heading, first appearance of rust, and per cent of stem rust infection at maturity were recorded for each variety.

The following table gives the per cent of stem rust infection at maturity for each of the varieties each year they were grown. The average per cent rust for each variety is also given.

The last column in the table, called the "group" column, has been based on the amount of rust in the "average" column.

Per cent stem rust infection at maturity.

Variety name	Per cent rust infection						Group*
	1924	1925	1926	1927	1928	Average	
Iogren	75	25	85	50	5	48	IV
Ruakura	70	40	50	10	8	36	IV
Red Rustproof	50	15	75	75	45	52	IV
White Russian	trace	5	3	30	trace	8	II
Swedish Select	45	40	65	75	5	46	IV
Joanette	10	15	70	40	5	28	III
Iowar	15	25	35	10	5	18	III
Richland	trace	2	10	trace	trace	2	I
Fulghum	50	35	25	25	10	29	III
Burt	35	20	20	50	5	26	III
Rustless	25	20	30	15	2	18	III
Heigira Rustproof	trace	0	5	40	trace	9	II
Silvermine	85	30	95	75	15	60	IV
Wolverine	...	45	75	75	30	56	IV
Green Mountain	...	8	5	50	trace	16	III
Anthony	...	8	10	20	trace	10	II
Minota × White Russian	...	15	10	20	trace	11	II
Gopher	...	...	40	40	8	29	III
Kanota	...	...	45	25	8	26	III
Markton	...	...	45	75	15	45	IV
Iogold	...	...	3	trace	0	1	I
Iowa 444	...	...	5	10	trace	5	I
Selection 459-14-3	...	...	...	trace	2	1	I

*Group I, 0-5 per cent; very resistant. Group II, 6-15 per cent; fairly resistant. Group III, 16-30 per cent; fairly susceptible. Group IV, 31 per cent or more; very susceptible.

Discussion

The varieties showing greatest resistance (Group I) are Kherson type oats, three of the varieties being selections from Kherson. They are early maturing, a characteristic that often enables them to escape rust injury.

Varieties showing fair resistance (Group II) are of the White Russian type. One of the varieties is White Russian; two others are selections from crosses in which White Russian was one of the parents.

The varieties that are fairly susceptible (Group III) are largely red or sterilis type oats. Two varieties, however, are selections from Kherson. Though both are early oats, they are fairly susceptible to the rust.

Of the varieties that are very susceptible (Group IV), two (Ruakura and Markton) have been developed from imported oats. Iogren is a selection from Green Russian.[7] Red Rustproof is a sterilis type grown

[7]The Green Russian is not to be considered as synonymous with White Russian previously mentioned.

in the South. Swedish Select is the old standard Swedish Select type that has been grown in this country for many years. The other two varieties, Silvermine and Wolverine, belong to the Silvermine type.

When we consider that practically all of the oats grown in Michigan belong to either the Swedish Select or Silvermine type[8] it is not surprising to find heavy losses due to rust in years when the disease is severe. Both types are, as shown by the table, found in Group IV which is the most susceptible to rust. These types have always yielded heavily in the Lower Peninsula where the rust has rarely been of a serious nature. They also yield well in the Upper Peninsula in years when the rust epidemic is not serious. However, conditions in the Upper Peninsula are such that severe attacks of rust are common and the losses of the Upper Peninsula farmer are great.

Summary

1. There is a wide range in susceptibility to stem rust among the several varieties tested.
2. Oats derived from the Kherson or White Russian types have been more resistant to the rust than those of any other types tested.
3. The fact that two Kherson selections were in Group III, susceptible to rust, would indicate that the Kherson selections in Group I are truly resistant to the rust and not merely early enough to escape it.
4. Wolverine and Swedish Select are comparatively susceptible to stem rust.
5. Further studies are needed, especially on those varieties that have been in the test for only two or three years. Resistant varieties are being tested in yield series to determine their practical value.

MULCH PAPER FOR VEGETABLE CROPS IS TESTED

Warm Season Crops Show Greater Response Than Cool Season Crops

BY J. B. EDMOND, HORTICULTURAL SECTION

Within the past two years, articles have appeared in numerous agricultural magazines and trade journals on the use of paper mulch in growing garden crops. These articles have been based both on results obtained by growers of pineapples in Hawaii and on experiments conducted in various parts of this country with vegetable crops. Though the use of paper as a mulch for pineapples has proved particularly advantageous under Hawaiian conditions, the results of experiments with this material on vegetable crops are somewhat conflicting. In some cases, increased yield and earliness have been reported; in others,

[8]The Worthy oats grown in Michigan are also a Silvermine type of oat.

results have been somewhat unfavorable. In general, the experiments have indicated that the so-called warm season crops are likely to show the greater response.

Advantages claimed for using paper as a mulch are as follows: Preserving moisture and fertility by eliminating weeds and preventing excessive leaching during heavy rains; reducing evaporation; raising soil temperature; facilitating root development; totally or partially eliminating weeding and cultivating; increasing yields and earliness of maturity; and maintaining better physical condition of the soil. Disadvantages claimed against the paper are the initial high cost and the difficulty in applying and anchoring, especially during windy weather.

Growers in Michigan have manifested considerable interest in the practicability of this new method of soil management. Accordingly, the Department of Horticulture conducted a preliminary test with paper mulch on certain vegetables during the growing season of 1928. The results are reported in the following paragraphs.

Plan of the Experiment

A plot of land, which was 140 feet long and 40 feet wide, was divided into four equal parts; each alternate part was covered entirely with paper, except the space occupied by the plants in the row. The remaining parts were given ordinary cultivation. Weeds were controlled by hand hoeing. The soil is a fairly uniform sandy loam, gradually sloping to the north. A basic treatment consisting of 500 pounds to the acre of 4-8-6 fertilizer was broadcasted when the soil was prepared for planting.

The seed of all the crops, except tomatoes, peppers, and cucumbers, was planted by means of a Planet Junior drill. One row was given over to each crop, except sweet corn, of which four rows were planted. Lettuce, beets, carrots, and beans were planted in rows 18 inches apart; peppers and sweet corn 36 inches apart and tomatoes and cucumbers 48 inches apart. Lettuce was thinned to stand eight inches apart in the row, beets and carrots six inches apart, sweet corn and beans one foot apart, cabbage and peppers two feet apart, tomatoes three feet apart, and cucumbers to two plants per hill three feet apart.

Mulch paper, known as "Gator Hide," in widths 18 and 36 inches, was laid in the rows immediately after the seed was planted and fastened down either by soil, long wire staples or stones.

Weather Conditions

Unusually cool and wet weather prevailed during the first two weeks in June. Thereafter temperature and precipitation were above average for Michigan until the latter part of July. The first part of August was somewhat cool and dry. During the remainder of the growing season, temperatures were normal and precipitation slightly above the average.

Results

The tabulated data show an increase in total yield and earliness of beans, cucumbers and sweet corn and in total yield of cabbage, tomatoes and peppers in favor of the paper mulch. Of these crops cucum-

Effect of paper mulch on total yield and earliness of yields of vegetable crops, 1928

Crop	Early yield[1]		Total yield	
	Mulched	Unmulched	Mulched	Unmulched
Lettuce (May King)[2]			0 63	0 72
Beets (Detroit Dark Red)[2]			0 25	0 27
Carrots (Danvers Half Long)[2]			0 29	0.27
Cabbage (Danish Ball Head)[2]			5 84	4 49
Tomatoes (John Baer)[2]			12 68	4 48
Beans (Pencil Pod Black Wax)[2]	0 38	0 22	0 43	0 24
Peppers (Harris Early Giant)[3]			9 44	4 57
Cucumbers (Early Fortune)[3]	6 22	2 99	20 70	7 37
Sweet Corn (Golden Bantam)[4]	0 48	0 41	0 99	0 90

[1]First two to four pickings.
[2]Pounds per plant of edible portion.
[3]Marketable fruits per plant.
[4]Marketable ears per plant.

bers produced the greatest differences, and sweet corn the least. The mulch failed to produce any marked influence on total yield of lettuce, beets and carrots.

On the mulched plots the beans were larger and more vigorous. The pods were slightly longer. The sweet corn grew somewhat more rapidly, resulting in the slight increase in earliness of maturity. The ears were somewhat longer with a resulting production of a smaller percentage of nubbins. The cucumber fruits were longer and more slender than those marketed from the unmulched plots: Vines were larger, more vigorous and apparently more resistant to certain diseases. During the dry weather in the early part of August the vines in the unmulched area wilted down frequently. The cabbage on the mulched plots produced very large heads equally as solid as those marketed from the unmulched area. The roots of carrots and beets were slightly shorter than those grown on the unmulched treatment. In both cases the surface of the ground was extremely hard and baked making harvesting extremely difficult. No significant differences were noticed from the two treatments with lettuce.

The data seem to indicate that paper mulch is likely to be more beneficial on the warm season crops, especially during periods of midsummer drought. However, since the experiment was conducted for only one year on one type of soil, and since the costs of the two treatments were not compared, the figures cannot serve as a basis for either recommending or condemning the practice. The profitable use of paper as a mulch on cool season crops is questionable. Its use on warm season crops having a high cash value and grown for early market may be decidedly advantageous. In any case the paper should be used in an experimental way only until the practicability of its use is definitely established.

VANILLA FLAVORS DO NOT FREEZE OUT OF ICE CREAM

Trials Show Flavoring Added To Ice Cream Is Not Lost During Storage

BY P. S. LUCAS AND A. C. MERRILL, DAIRY SECTION

The use of vanilla beans and their extractive material by the white race dates to the time of the Cortez conquest of Mexico. The use of vanilla as a flavoring material had apparently been known to the Aztecs for centuries and the source of supply was the wild vanilla plant indigenous to Mexico. From the meager literature available, it would appear that vanilla was used chiefly in chocolate drinks, the bean being placed in the concoction either entire or in a ground state. This new flavor became popular in England during the reign of Queen Elizabeth, chocolate shops becoming almost as popular as the coffee shops. Besides its use in drinks, vanilla was used with lavender in perfume sachets because it appeared to retain its perfume over long periods of time.

Over half of the ice cream made in the United States is flavored with vanilla. The vanilla used may be the beans finely ground or ground finely with sugar but the more common form is that of the alcoholic extract. Four classes of beans are on the market, the Mexican, Bourbon, Tahiti, and Vanillons or wild varieties. These are named in order of their cost, the Mexican being most costly. Vanilla extract has at times been blended with that of the Tonka bean, a bean that has a flavor closely resembling the perfume of sweet clover. A second material used in some extracts is vanillin. This is the chief, though not sole, flavoring principle found in the vanilla bean and may be extracted from materials other than the bean itself. Since, to be a flavor, an extract must be more or less volatile, the belief has grown up among ice cream men that vanilla flavors gradually disappear or "freeze out" of ice cream during the time that the ice cream is held in cold storage. This belief has caused many manufacturers to reinforce their flavors by adding vanillin or coumarin. This usage has been thought by many to not only strengthen the flavor but also to reduce the dissipation of the flavor as the cream is held in the hardening room.

To test the tendency, if any, of varying types of vanilla flavors to "freeze out" the following flavors were made:

1. All Mexican bean single strength extract.
2. Mexican and Bourbon bean concentrate.
3. Mexican and Bourbon bean concentrate with coumarin.
4. Mexican and Bourbon bean single extract with vanillin.
5. Mexican and Bourbon bean single extract with coumarin.
6. All Bourbon bean single strength extract.
7. Mexican and Bourbon single strength extract.
8. All Tonka bean single strength extract.

Experimental Methods

These extracts were added in proper amounts to ice cream mixes which had exactly the same composition, the mixes were frozen in an identical manner, and samples were taken and held in storage. After a week's storage, a new series was frozen and the previous week's samples were scored against the fresh samples to detect a possible diminution in the strength of the flavor due to storage. This procedure was repeated until twelve series had been completely scored at the end of a week, a month, and a three-month storage period.

No lessening in the flavor strength after storage could be detected by any of the scorers. This held true with single strength extracts as well as for those reinforced with coumarin or vanillin. Care was taken to allow a brief interval of time between the sampling of each product so as to avoid, as much as possible, the chilling of the mouth with consequent numbing of the sense of taste. Slight oxidation of the butterfat could be noted after a month's storage but this so far as could be observed had no effect whatever on vanilla flavor strength.

A very considerable difference in the desirability of the various flavors was noted. The flavor made in the form of single strength extract from all Mexican beans scored highest. Such an extract imparts a mild smooth flavor that, while the ultimate for the trained taste, might be regarded as a trifle too subdued for the average taste. This criticism was overcome by the use of a mixture of Mexican and Bourbon bean extract, although it was done at the expense of smoothness. Concentrated extracts gave very desirable results and were for all practical purposes, when made of like raw materials, as good as the single strength extracts. The addition of vanillin seemed to lower but very slightly the bouquet of the flavor and did not assist in retention of flavor. The addition of Tonka extract or its flavoring principle, coumarin, affected the desirability of the flavor, when judged from the vanilla flavor viewpoint, because it added a rank, coarse taste which was foreign to the true flavor of vanilla beans.

Test of Volatility

To test the volatility of vanilla extract, an apparatus was set up in which air was passed in a stream through an extract for a period of eight hours. This extract was then used in an ice cream and its strength of flavor checked against an identical ice cream in which a normal non-aerated flavor was used. In the several trials made with various extracts, none seemed to be adversely affected by the aeration although the temperatures used, 32° F., were much above those prevailing in the average hardening room.

"Heat shocking," the subjection of ice cream to slight melting and refreezing, causes many defects in the body and texture of ice cream. With the thought that such treatment might cause a noticeable volatilization of the flavor in the ice cream, several series of samples were exposed at room temperatures, replaced in the hardening room, and scored against freshly frozen hardened samples. While it is reasonable to suspect that subjection to room temperatures may cause dissipation of a portion of the flavor, there is nevertheless so little volatilization that the loss cannot be detected by taste, and is therefore so

small as to be of no practical importance. These observations, made under carefully controlled conditions, lead to the conclusions that vanilla used in any of its liquid forms in ice cream is very stable and shows no tendency to disappear from ice cream during its cold storage period.

TEST YIELDS FROM COMMERCIAL SUGAR BEET SEED

1928 Production Records Show Tonnage and Sugar Content Is Affected by Type of Seed

BY J. G. LILL, FARM CROPS SECTION, MICHIGAN STATE EXPERIMENT STATION, AND THE OFFICE OF SUGAN-PLANT INVESTIGATIONS, U. S. DEPARTMENT OF AGRICULTURE, CO-OPERATING

Through the courtesy of the Michigan Sugar Company, this test was conducted on their O'Keefe Farm near Saginaw, Michigan.

Fifty different brands of seed were included in this test. Each brand was planted on eight different plots, each of which had been prepared in a different manner from the others, but each brand of seed occupied plots prepared in the same manner as for the other brands of seed. In preparing the field for this test, it was divided into eight lands. Four of these lands, alternating, were plowed in the fall and the remaining four in the spring. In both the fall and the spring plowing, one land was plowed to a depth of four inches, one to six inches, one to eight inches, and one to 10 inches.

In planting, each brand was seeded in a continuous row which crossed the different dates and depths of plowing, thus securing for each one as wide a variation in the conditions as the methods of soil preparation would permit. The seed was sown on April 29, the seedlings were thinned on May 29, and the crop was harvested on October 9 and 10. The care given during the season was the same as that given any well tended field.

The seasonal conditions were slightly unfavorable. Excessive rain in June prevented a good start and decreased the yield to some extent.

One brand of seed was planted in every third row of plots as a control to check upon variations caused by differences in the productivity of the soil or other factors. The variations in stand, yield, per cent sucrose, purity coefficient, and ounces of sugar produced per plot which were shown by this control variety have been fully considered in preparing this report. Table I gives the performance of the control brand of seed in each row in which it was grown throughout the test and Table II gives the performance of the control on the different dates and depths of plowing. These results are stated on an acre basis.

The results presented in Tables I and II afford a measure of the conditions under which the various brands of seed were tested. The productivity of the soil varied to some extent, but it is believed that the greater variation which was caused by preparing the soil in the different manners offset this variation and made the test a fair one.

Table I.—Performance of the control by rows stated on an acre basis

Row number	Beets per acre	Tons per acre	Sucrose content per cent	Purity factor per cent	Sugar per acre, pounds
409	16172	7 473	17.20	86 66	2580.
412	15845	5 687	18 06	88.21	2061.
415	15890	5 091	17 84	87.69	1822.
418	16063	5 064	18 02	87.71	1839.
421	15954	5 785	17 90	87 57	2086.
424	16008	5.608	17 96	88 75	2013.
427	16389	5 717	17 59	87.87	1998
430	15573	5.200	18 00	87 95	1862
433	15899	6 235	17 80	87 28	2222.
436	16553	6 820	17 85	87 75	2415
439	16553	6 847	17.69	87.41	2415.
442	15137	6 207	17.90	87 97	2210
445	15682	5 717	18 20	88 22	2081.
448	16226	6 588	18 02	87.77	2357.
451	16008	4.819	17.59	87 45	1674.
454	15518	5.159	17 53	88 28	1806.
457	15899	5 472	17 64	87.94	1919
460	15518	4 628	17 63	88 62	1647.
463	16335	4 805	17 90	89 38	1732.
466	15791	6.480	17 90	89.32	2321.
469	15300	6 303	17.51	88 38	2209.
472	17696	6.929	17.47	87 85	2411.
475	16172	6 139	17.40	87 47	2127.
478	17860	6 561	17.73	89 55	2311
481	16988	6 929	17.26	89 06	2388.
484	17206	7 269	17 09	88 44	2499

Each figure is the result of eight determinations.

Table II.—Performance of the control by dates and depths of plowing. Stated on an acre basis.

Plowing	Beets per acre	Tons per acre	Sucrose content per cent	Purity factor per cent	Sugar per acre, pounds
Fall plowing:					
10 inches	16988	6 735	16 83	87 01	2266
8 inches	17525	7 112	17 35	87 79	2468
6 inches	17139	8.549	17 77	88.02	3028
4 inches	17374	7 510	17 93	88 18	2694.
Spring plowing:					
10 inches	14425	3 992	17 24	87 90	1383
8 inches	15280	4 976	17 88	88 26	1779.
6 inches	15581	5 546	18 38	89 28	2041.
4 inches	14944	3.439	18 39	88 32	1266.

Each figure is the result of twenty-six determinations.

Explanation of Symbols

The results given in this report were obtained by a compilation of the eight determinations made for each brand of seed tested. These results have been reduced to a direct comparative basis by approved statistical methods. The significance of the difference between the results given for any brand of seed and the results given for the control has been determined by "Student's Method" of statistical analysis. No brand of seed included in this test is shown to be significantly different from the control unless so indicated by the symbol following the result secured for that brand of seed. The significance is stated in odds of a certain amount to 1 that the difference between the results

secured was not due to chance alone but was, therefore, due to some quality of the seeds tested.

No symbol	Odds about even.
A	Odds at least 30 to 1
B	Odds at least 100 to 1
C	Odds at least 500 to 1
D	Odds at least 1,000 to 1

The results given in this table are not to be taken as a final statement of the date and depth of plowing project for the season of 1928, as they are only a part of the material included in the plowing project.

Table III.—Shows the number of times the result secured in the eight different determinations made for each brand of seed tested, equalled or exceeded the result secured from the control grown beside it

Designation (All seed believed to be of the 1927 crop except as indicated)	In stand per acre	In yield per acre	In sucrose content	In purity factor	In sugar per acre
UDYCZ "B"	7	8	6	6	8
Mayzel-Granum "Plenne"	8	8	7	8	8
Bielotzerkov "10 E"	7	8	4	3	8
Verchiatchka "3 N"	6	8	6	5	8
Heine Original	7	6	8	5	7
Uladovka "4 E"	6	7	3	4	7
Buszczynski's Neo Maximale	8	8	8	8	8
Buszczynski's Productive	7	8	7	6	8
UDYCZ "A"	7	6	7	3	8
Rimpau I	5	8	3	3	6
Braune Elite	5	6	1	3	7
Schreiber's "S. K. W."	7	8	5	6	8
*Dippe's "G. D. E"	7	8	2	4	7
S. W. H. N	5	7	6	5	7
R. & G. "ZZ"	7	6	8	5	7
Strube's Original Schlanstedt	6	7	3	6	6
August Knoche "Z"	7	6	5	2	7
Otto Dippe	7	8	0	5	8
R. & G. "Old Type"	4	6	4	5	6
*Buszcynski's Productive "S. E."	6	6	8	6	7
Albert Griesing-Sporen	5	6	2	3	6
Hartman's "Glostrup"	7	7	0	1	6
Hilleshog	8	6	7	5	8
Delitsscher	7	6	4	5	6
Zapotil	4	6	4	6	6
August Knoche "E"	8	7	1	2	7
*Canadian Grown	6	5	3	4	5
Ivanavka "2 N"	7	5	5	5	5
Z. & C. "R. W."	5	6	8	6	6
Granum "Cukrowe"	7	4	7	6	7
Schreiber's "S. S."	5	5	5	5	5
*Dippe's "G. D. R. K."	7	6	3	4	6
Braune "New Type"	5	4	1	4	5
R. & G. "Extreme Pioneer"	5	5	6	3	5
R. & G. "Pioneer"	4	4	7	8	5
*Vilmorin Brand	5	5	3	3	4
Z. & C. "R. S."	6	3	7	6	3
Braune Commercial	7	5	1	1	4
Janasz "A. J. I."	6	5	7	3	6
Wohanka "W. Z. R."	6	6	5	4	5
Horning	4	4	4	5	5
Sebline	7	3	3	5	4
Mette	4	6	7	6	5
Erhard-Frederiksen "Eagle Hill"	5	4	3	0	3
*Dippe's "G. D. Z."	5	2	4	3	3
Rimpau II	6	2	6	4	1
R. & G. "Normal Original"	4	3	1	4	2
Dippe's "G. D. W. I."	6	1	6	2	1
Dobrovice	1	0	3	4	0
*Royal Dutch Pedigree	4	1	6	4	0

Table IV.—Shows the comparative figures for each brand of seed tested

Brand designation and source (*P—Sample from producer) (*C—From commercial seed)		Stand per acre	Yield per acre, tons	Sucrose content per cent	Purity factor per cent	Sugar, pounds per acre
UDYCZ "B"	P*	19059-B	8.791-D	18.54-A	89.04	3287-D
Maysel-Granum "Plenne"	P	19399-B	8 705-C	18.44-B	90.39-D	3172-C
Bielotserkov "10 E"	P	18599	8.541-D	17.56	88.15	2992-D
Verchiatchka "3 N"	P	18108-A	8.131-D	18 19	88 23	2951-D
Heine Original	C*	19901-B	8.028-A	18 25-D	88 27	2898-A
Uladovka "4 E"	P	17532	8.141-B	17.53	87.97	2865-A
Busscsynski's Neo Maximale	C	18777-C	7.545-B	18 86-D	89 69-B	2864-D
Busscsynski's Productive	C	18951-B	7.563-D	18.74-B	88.93	2841-D
UDYCZ "A"	P	17933-A	7.549-A	18.38-B	88.36	2778-B
Rimpau I	P	17163	8.008-B	17.36	87.73	2774-A
Braune Elite	P	18019	8.010-A	16.89-B	87.19	2680-A
Schreiber's "S. K. W."	C	18749-B	7.451-D	17.91	88.80	2676-D
*Dippe's "G. D. E."	P	17634	7.757-B	17.17	88 75	2655-B
S. W. H. N.	C	17772	7.311-B	17.96	88 78	2640-B
R. & G. "ZZ"	P	18030-A	6.793	18 83-C	88.71	2558-A
Strube Original Schlanstedt	C	18778-A	7.146-A	17.94	89.28	2544-A
August Knoche "Z"	P	18066	6 985	18 19	87 56	2519-A
Otto Dippe	C	18079	7 320-A	17.38-C	88 05	2514-A
R. & G. "Old Type"	P	17203	7 088	17 74	88.44	2509
*Busscsynski's Prod. S. E.	P	17849	6 599-A	19.09-C	89 39-A	2489-C
Albert Griesing-Sporen	P	17403	7.329	17 22	87 41	2498
Hartman's "Glostrup"	C	17859-A	7.413-A	16 60-B	86.02-A	2463
Hilleshog	C	19967-D	6 744-A	18 30-B	88.45	2450-B
Delitscher	C	18030-B	6 955	17.60	88.38	2442
Zapotil	C	16377	6.857	17.83	89 04	2437
August Knoche "E"	P	17982-A	7.046-A	17.23-B	87.71	2419-A
*Canadian Grown	P	17306-A	6.759	17.88	88.33	2417
Ivanovka "2N"	P	18560	6.708	17 93	88.49	2403
Z. & C. "R. W."	P	18126	6 290	18 99-D	89 15	2388
Granum "Cukrowe"	P	17716	6 264	18 62-A	88.77	2359
Schreiber's "S. S."	C	17144	6 535	17.75	89 15	2296
*Dippe's "G. D. R. K."	P	19307-B	6 576	17 23	87 88	2280
Braune "New Type"	P	17664	6 503	17 43	88.58	2269
R. & G. "Extreme Pioneer"	P	16614	6.243	18 12	86 99	2265
R. & G. "Pioneer"	C	16156	6.166	18.20-A	89 43-B	2244
*Vilmorin Brand	P	16539	6.463	17.29	87 60	2234
Z. & C. "R. S."	P	17080	5 879	18 90-B	89.30	2220
Braune Commercial	C	18169	6.617	17.05-A	86 90	2219
Janass "A. J. I."	P	19093	5.954	18.60-B	87.36	2219
Wohanka "W. Z. R."	C	17710	6.035	18 19	88.41	2204
Horning	C	16581	6.095	17 88	88 02	2187
Sebline	P	17901-B	5.950	17 89	88 95	2146
Mette	C	16820	5 950	18.09	89.10	2141
AVERAGE OF 208 CONTROLS	P	16156	5.982	17.72	88 10	2116
Frederiksen's "Eagle Hill"	C	15938	5 941	17.29	86.35-B	2082
*Dippe's "G. D. Z."	P	16831	5 771	17.75	87 32	2053
Rimpau II	P	16906	5.726	17 64	88.27	2004
R. & G. "Normal Original"	C	15883	5.107	17.26-B	88.07	1776-A
Dippe's "G. D. W. I."	C	17093	4.801-A	17 96-A	87 98	1738
Dobrovice	C	13765-B	4.723-D	17 65	88.45	1683-C
*Royal Dutch Pedigree	P	16701	4.443-B	17 99	87.73	1586-B

*This seed was from the 1926 crop.

In Tables I, II, and IV, the figures showing the pounds of sugar per acre are not calculated directly from the figures in the yield and per cent sucrose columns, but are derived from the actual number of ounces produced upon each plot included; therefore, these columns in these tables will not cross check.

All analyses considered in the preparation of this report were made by the Chemistry Section of the Agricultural Experiment Station.

As the sucess of this test depends to a very large extent upon the co-operation of the sugar beet breeders, the American representatives of the seed breeders, and the various sugar companies operating throughout the United States, this opportunity is taken to express our appreciation for the excellent co-operation received from these various sources. Since this test will be conducted again in 1929, the various

agencies are requested to submit five pound samples of the various brands of seed for use in the 1929 test. On account of the number of samples that were received for the 1928 test, it is necessary to restrict the testing to samples of standard brands put on the market by recognized breeders. Samples submitted for this test must be of standard brands and must be plainly marked with the brand designation and the name of the agency submitting them.

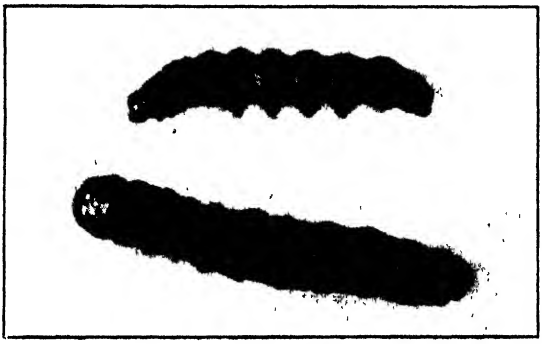
BORER DAMAGES GOLDEN GLOW PLANTS

Life Habits of Insect Somewhat Resemble Those of European Corn Borer

BY E. I. MC DANIEL, ENTOMOLOGICAL SECTION

From time to time, borers working in the roots of golden glow have been sent in for determination from various localities in Michigan. Larvae coming to us in this way have been repeatedly bred out and have produced the adult of *Epiblema carolinana.** The casual occurrence of this insect at first aroused very little interest, but the advent of the European corn borer, *Pyrausta nubilalis,* has awakened our interest in all larvae having the habit of boring into plants. Furthermore, these two species somewhat resemble one another in a superficial way and the life history of the golden glow borer corresponds rather closely with that of the single brooded race of the European corn borer.

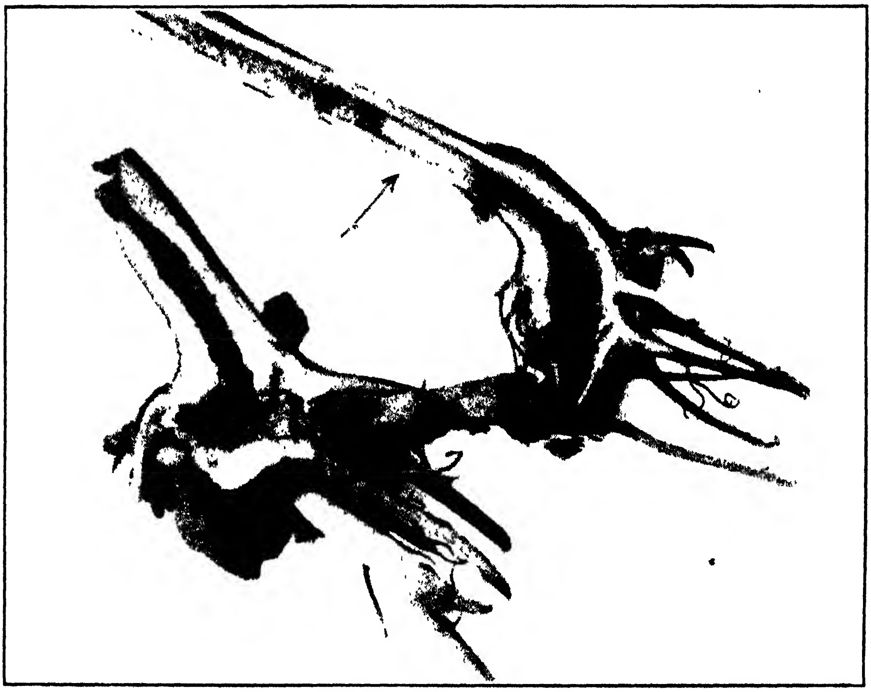
The inconspicuous night flying moths or millers, which are the adults of this species, are silvery grey in color and measure from one-half to three-fourths of an inch across the expanded wings. The moths appear about the first of July, although adults have been taken as late



Golden Glow borer, enlarged.

*An excellent account of the life history of this species has been published by Mr. R. W. Thompson, 58 Ann. Rept. Ent. Soc. Ontario, 1927, pp. 73-75.

as the middle of August. The females live for about two weeks, during which time each individual places from 25 to 50 eggs singly in the blossoms of golden glow. These eggs hatch in four or five days and the tiny larvae feed within the flower until after the third instar, when they descend to the ground, letting themselves down by silken threads. Each one then searches out a plant and usually enters the stalk two or three inches above the soil. From this point it works down to the main roots where it excavates a large tunnel. The larvae, like those of the European Corn Borer, reach maturity before cold weather sets in, though they remain in the under-ground tunnels until spring when pupation takes place.



Work of borer in roots of Golden Glow.

Injury

Little or no injury has thus far been attributed to this species, though, when young buds are attacked, such buds occasionally develop into one sided flowers. The larvae, after they enter the roots, seldom attract attention because most of the larvae are in the main roots where there is sufficient material to support both borer and plant.

Control

Cut and destroy infested flowers and buds while the larvae are small and before they reach their third instar. After the larvae get into the main root system they are too deeply inbedded in the plant tissue to

be controlled by contact insecticides. Unless the infestation is unusually severe, parasites will usually keep the percentage of borers down to a safe number.

STUDY MADE OF GARDEN TRACTOR IN MICHIGAN

Small Type Tractor Proves Satisfactory For Gardening and Other Purposes

BY E. C. SAUVE, AGRICULTURAL ENGINEERING SECTION

The garden tractor, during the past two years, has had an increasingly wide usage in Michigan. A survey just completed by the Agricultural Engineering Section of the Michigan Experiment Station shows that the tractor is recognized by many as a very satisfactory means of cultivation on small areas and for special crops.

The survey indicates that the garden tractor is used on conditions and types of farming as follows:

1. Small acreages

   For those living near large cities, where an acre or two has been retained for the purpose of providing a home and garden. Frequently, the income from the produce of these small acreages is supplemented by the income of other employment in the city. Under these conditions, keeping a horse is impracticable.

2. Medium sized acreages

   On which specialized crops such as onions and celery are grown. Due to the fact that onions are grown in narrow rows, horses cannot be used without serious damage to the crop. It is a question of substituting mechanical power for man power. Owners generally agree that under these conditions the garden tractor is a time and labor saver.

3. Large acreages

   Though but few owners have reported the use of a garden tractor on large acreages to supplement other forms of power, it appears that this type of power may prove satisfactory and economical when a considerable portion of the farm is devoted to narrow row crops and, if, in addition to its work performed in the field, it can be substituted for the stationary engine for operating light machinery, such as pumps, washers, grinders, and the like.

Makes of Tractors Used

There were 112 garden tractors represented in the survey. The names of the tractors and the number of them in use were Bolens 43,

Centaur 22, Midwest-Utilitor 17, Standard 10, Red-E nine, Gravelly three, Beeman three, Shaw two, Federal one, Gromor one, and Kinkade one.

Twenty-five per cent of the total number of owners had used their tractor one year, 40 per cent two years, 19 per cent three years, and 16 per cent from four to 10 years. Seventy-five per cent of the machines had been used for two years or more.

In answer to the question, "Does your tractor effect a saving in comparison with other forms of power?" 85 per cent of the owners declared positively that their garden tractor effected a saving, four per cent declared positively that the garden tractor did not effect a saving, and the remaining 11 per cent were undecided.

Reported Advantages of the Garden Tractor

1. The overhead cost of a garden tractor when not in use is low as compared to other forms of power.
2. The operation cost of a garden tractor is low.
3. The garden tractor when properly handled does not destroy the plants.
4. The garden tractor is a labor and time saver.
5. The garden tractor may be adapted to belt work.
6. The small sizes are especially adapted to narrow row crops.

Reported Disadvantages of the Garden Tractor

1. Lacks traction in sandy soil.
2. Difficult turning at end of rows in some cases.
3. May have poor service on repairs.
4. High initial cost.

Selection

Most garden tractor owners who operate small acreages, and these are in the majority, desire that the tractor should perform the operations of plowing, fitting, and cultivating. With the more experienced users, it is found that the small tractor is too small for preparing the seed bed, and the larger garden tractors are too large for efficient cultivation of narrow row crops. Since cultivating is the major function of the garden tractor, it would seem that this should be given first consideration. Usually where a small garden tractor is used, plowing and fitting of the land is done with other forms of power. The findings, as reported above, might suggest the use of two garden tractors, one for preparing the seed bed and one for cultivating the crop. Whether this is feasible should be decided on the basis of conditions in individual cases. In general, it does not appear practical or economical to own both a large and a small garden tractor for the following reasons:

1. With few exceptions, acreages are too small to justify the extra investment.
2. For large acreages, plowing and fitting can be done cheaper with the larger power units such as horses or the regular farm tractor.
3. With only a few days necessary for the plowing and fitting operations, the large garden tractor would be idle most of the time; and,

taking into account overhead costs, this would make the cost of work done per acre excessively high.

4. The larger garden tractors are too small to handle efficiently the major belt jobs on the farm.

Although the use of two tractors appears impractical, it is not implied that the larger garden tractor has no place as a general purpose machine, in market gardening operations.

The survey shows that, with wide row crops and not too large acreages, the large garden tractors are satisfactorily meeting the requirements of their owners in completely handling the crop from plowing to cultivating.

Points to Consider in Garden Tractor Selection

1. Availability of quick service is the first and most important consideration in the selection of a garden tractor.
2. The initial investment should be second in importance to service.
3. The tractor should be well-balanced and easily controlled by the operator.
4. Ability to make short turns with little manual effort is desirable.
5. No tractor is mechanically perfect. However, the quality of workmanship and material in all garden tractors of reputable makes are good. Breakage will occur on all when unusual stresses are applied.
6. Buy only from reputable concerns.

Uses for the Garden Tractor

Garden tractor power has, according to the survey, been used on drawbar for plowing, harrowing, rolling, drilling, cultivating, hauling manure, moving small buildings, mowing lawns and small acreages of alfalfa, and stretching wire fence. It is used for belt power for washing machines, emery-wheels, feed mills, pumps, cement mixers, saws and churns.

Cost of Operation

Since garden tractors have been classed according to the types of work for which they are best fitted, namely; cultivating or the combined duties of plowing and fitting, the cost figures will be presented on a basis of the small and the large types. The average cost of small garden tractors, including the necessary tools, is $250. These tractors were used on the average 141 hours each year for an estimated life of seven years.

Yearly fixed costs are as follows:

Depreciation, 14.3% of investment	$35.75	
*Interest 6% of average investment ($142.85)	8.57	
Repairs, 4%	10.00	
Incidentals, 2%	5.00	
Total yearly fixed costs		$59.32

*Note: The average investment is determined as follows:

$$\text{Average investment} = \frac{\text{first cost} \times (\text{years of service} + 1)}{\text{years of service} \times 2}$$

Yearly operation costs based on 141 hours of work per year:		
Fuel cost (2 gallons per 10 hour day) 28.2 gallons at 18 cents per gallon	$5.08	
Oil cost, 2½ gallons at 80 cents per gallon	2.00	
Total fuel and oil cost		7.08
The total yearly fixed and operating cost not including labor		$66.40

The total hourly cost not including labor equals

$$\frac{\$66.40}{141} = 47 \text{ cents per hour}$$

The average cost of the larger garden tractor, including the necessary tools, was $483. The hours worked per year were 313, with an estimated life for the tractor of eight years. Using these figures and calculating on the same basis as above, the total cost, not including labor, is equal to 45 cents per hour. The lower cost per hour figure for the larger tractor is due to the fact that the costs are spread over more than twice as many hours as for the small tractor.

In conclusion, it would appear that the garden tractor is approaching the degree of satisfactory performance found in the larger farm tractor. It is important to bear in mind that the garden tractor, like other machinery on the farm should be put to the greatest possible number of uses in order that the fixed or overhead costs may be spread over the greatest number of operations to get a reduction of the unit cost of power.

SODIUM CHLORATE SPRAY CONTROLS QUACK GRASS

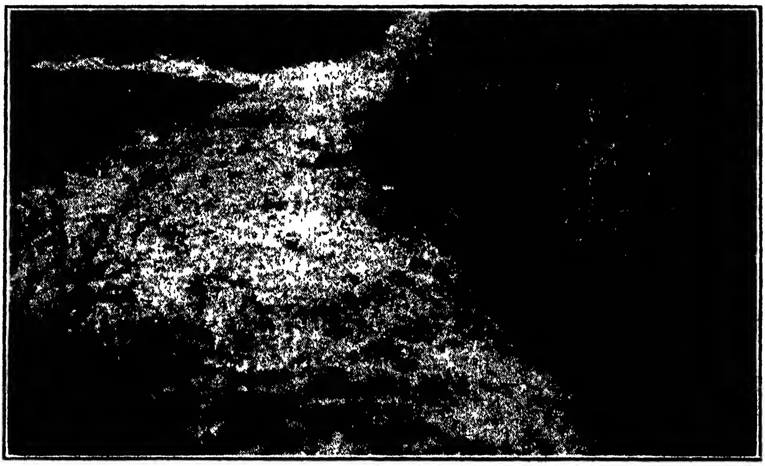
Experimental Results Indicate This Chemical Important Aid In Destroying Quack

BY C R. MEGEE, FARM CROPS SECTION, AND R. S. HUDSON, FARM AND HORSE SECTION

Quack grass is a perennial with comparatively large quantities of reserve food material stored in its extensive root and rootstock system. Any successful method of control must either kill the plant outright or deplete this store of reserve food material. These ways of destroying the plant are not easy to accomplish, nor are there any easy methods of controlling this pest. However, fields of dense quack grass sod have been successfully controlled at the Michigan Experiment Station by proper plowing and cultivation so that, after control measures had been practiced, excellent yields of corn, oats, and alfalfa were secured.

Propagation of quack grass may be by seeds, but, far more frequently, the plant multiples by means of new shoots developing from the nodes or joints of the rootstocks. Small patches of quack grass should be handled carefully so that pieces of rootstocks will not be transplanted to uninfested land and establish new areas.

Spraying with sodium chlorate is still more or less in the experimental stage but preliminary tests indicate this chemical offers some advantages in quack grass control. Small patches of quack grass and other troublesome weeds may be controlled without cultivation and without danger of being spread to other parts of the field. Sodium chlorate is not expensive and the spray is easy to apply.



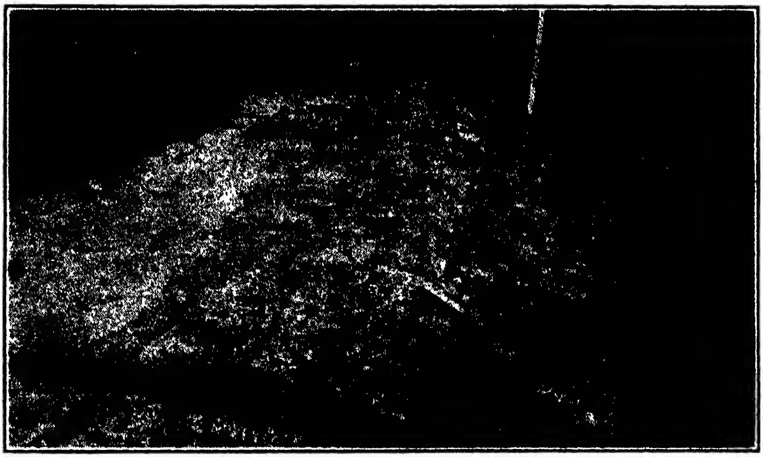
Sodium chlorate is very effective in preventing the spread of quack grass into lawns and under shrubs.

Sodium Chlorate Treatments

At the Michigan Experiment Station, quack grass sprayed with sodium chlorate during late May and again during middle June, in 1928, was very effectively controlled, the spray being about 99 per cent efficient. Preliminary tests indicate that the first application should be fairly heavy and that this should be followed with a lighter second application when the quack grass has resumed growth. Good results have been secured by dissolving sodium chlorate at the rate of one pound to a gallon of water and applying this solution at the rate of from 100 to 150 gallons per acre for the first application and 100 gallons per acre for the second application. An area 20 by 20 feet should receive about one and one-half gallons of spray for the first application and from three-fourths to one gallon for the second. Whether or not two applications will control the quack grass depends upon factors not well understood at the present time. In some of the tests two applications have been very effective but in other tests three or more applications were necessary.

Statements vary on the question of whether or not sodium chlorate has a detrimental effect upon the soil. It is likely that there will be a decreased yield from crops planted on sprayed areas within a few months after its use; just how long such an influence will be evident will depend upon the nature of the soil, the amount of rainfall, and the rate of application of the material. It is not likely that this detrimental effect will last more than one season in the majority of cases.

Sodium chlorate may be applied to fence rows and small areas by means of a hand pressure sprayer. An ordinary power spraying outfit may be used for larger areas. The potato sprayer may be used by turning the nozzles to the front and applying half of the material and then straddling the sprayed strips as the remainder of the material is applied, to secure a more even distribution.



Sodium chlorate promises to be effective in controlling quack grass along fence rows.

Sodium chlorate is not poisonous to stock unless taken in large doses. A portion of a 15 acre field of quack grass at the Michigan Experiment Station was sprayed with sodium chlorate and sheep were allowed to remain in the field. No injury to the sheep was noticed. These sheep had all of the common salt and mineral mixture they cared for and there was an abundance of unsprayed pasture available. A sprayer used throughout the season for applying sodium chlorate showed no unusual deterioration. It was usually cleaned after using.

Caution—Clothing saturated with sodium chlorate should be washed before it is allowed to become entirely dry. When allowed to become dry before washing, the sodium chlorate may ignite if the clothing is being worn and this results in serious injury to the wearer. Rubber boots should be worn when sodium chlorate is being applied to weeds and any excess of the chemical may then be washed off. Do not **drop** sodium chlorate—**it is explosive.** However, this chemical is not dangerous to handle if it is not dropped nor allowed to dry on the clothing.

Cultivation and Rotation

A method that has given very good satisfaction at the Michigan State College consists of deep fall plowing nine or 10 inches, followed with shallow spring plowing, four or five inches. The work must be done carefully so that all land will be turned or balks and poorly turned furrows will form bases from which the quack grass will continue to spread. We plow deeply in the fall so that time may be taken to dig out all stones, stumps, or obstructions which might prevent a satisfactory job of plowing. Poor plowing followed by the use of a spring tooth harrow is one of the best methods for thoroughly spreading quack grass over a field or farm.

After good plowing, the seed bed is carefully and thoroughly fitted for corn or any other clean-cultivated crop. Oats seeded to alfalfa follow the corn crop. The alfalfa is allowed to remain four or five years. This method does not always entirely rid the land of quack grass but it does control it so that good yields of field crops may be secured.

Combination Spray and Cultivation

A method which combines spray treatments and cultivation has been tried only in a preliminary way but is thought to have possibilities. A portion of one field was sprayed with sodium chlorate and then both the sprayed and unsprayed parts plowed. The quack grass was far more vigorous on the unsprayed portion.

Smothering

The smothering of quack grass with tarred paper, boards, or canvas is sometimes successful. Usually, however, the paper becomes torn and the boards separated so that the quack grass soon finds a place to creep through and resume its growth.

Further investigations of spray treatments and cultural methods for the control of quack grass are being continued at this Institution and it is expected that more efficient methods of controlling this serious weed pest will be developed.

ELITE POTATO SEED PRODUCED TO AVOID DISEASE

Development of Strains From Single Tubers Furnishes Pure Stock for Growers

J. E. KOTILA AND G. H. COONS, BOTANICAL SECTION

The production of certified seed potatoes in Michigan has become in the last decade an outstanding feature in Michigan agriculture. The development of this seed business in which specialists of Michigan State College have always had a guiding part is one of the noteworthy contributions of the College to agriculture.

The beginning of scientific seed potato production in the United States traces back to a conference of plant pathologists in Philadelphia, in 1914, when Dr. W. A. Orton, of the United States Department of Agriculture, detailed the methods successfully put to use in Europe to combat the ravages of the various virus diseases such as leaf roll, mosaic, and curly dwarf, which were then just beginning to be recognized as the real cause of the "running out" of potato seed stocks. The result of Dr. Orton's conference was the launching in the various States of the inspection services, now familiar to all potato growers, the organization of state potato associations, and a renewed interest in the production of the crop.

Michigan through the plant pathology specialists and the extension service took stock of the potato crop. It was soon apparent that no seed stocks, which were then available would pass even the lax inspection standards of the period. The potatoes were mixed in variety, badly diseased, and of unknown producing quality. Purchases from other States did not remedy the situation. For example, the best stock of Irish Cobbler potatoes available from a neighboring State produced so few typical Irish Cobbler plants that these were staked to furnish a meager supply for the next season.

The survey brought to light the Russet Rural potato and introduced it far and wide in Michigan. A large number of growers became interested in making potato seed stocks true to name, eliminating disease, roguing out sports, and hill selecting for yield. The program, we believe, was wisely planned and no attempt at certification was made until quality material had been developed. The history of the next few years showed marked growth in the potato certification movement. The stocks furnished gave general satisfaction and one state after another came to rely upon Michigan farmers and Michigan inspection service for their seed stocks.

It is the purpose of this article to discuss frankly the problems and needs of this growing seed potato business. This article should not be construed as a criticism of certified potatoes for use as seed stock. These still are the only safe material for growers to plant. The work

here detailed seeks merely to further improve the quality of potato seed stocks by reduction of disease infestation.

It has been the common experience of one grower after another to find that after a few years of successful production of potatoes for sale as seed, his fields fail to pass inspection and he had to start afresh. One heralded strain after another has arisen and then fallen into disrepute. To the farmer, this waxing and waning is as much a mystery as the old fashioned "running out of stock" was in former days. The farmer, even though he listens patiently to the explanations of the trained inspectors, still is mystified by the progress of the virus diseases in his field.

The diseases such as leaf roll, the mosaics, spindle tuber, spindling sprout, streak, curly dwarf, giant hill, and the like are virus diseases whose cause is still unknown. Scientific investigation has shown that these diseases spread from plant to plant, usually through the agency of plant lice which serve as vectors of the virus. A plant once diseased never recovers, although occasionally a few of the tubers produced by such a plant may not harbor the virus. In the old days, it was not uncommon to find 50 per cent or more disease in fields. Now the better fields show less than five per cent of disease of this type, but such a sprinkling of disease in the field may, if aphids are plentiful, mean a crop with a five or ten-fold infestation of disease the next season.

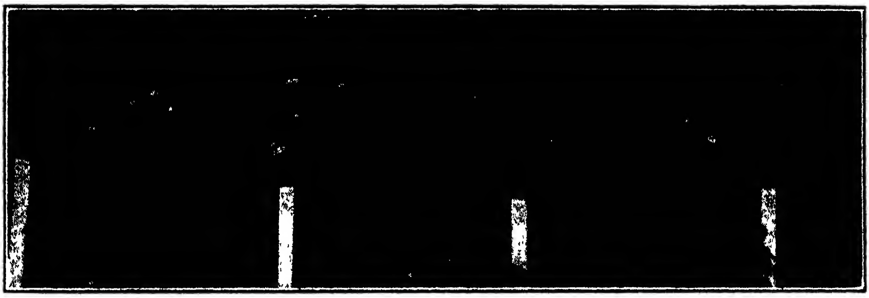
Elimination of disease by roguing is of value if begun in time and carried on thoroughly enough and this method has been relied upon to clean up the fields which are slightly diseased. It is obvious that once the diseases of this type are entrenched in a seed stock, the complete clean-up is not possible, especially when we consider that some cases are masked under ordinary field conditions, that is, they are present but cannot be detected by inspection. With the general run of certified seed stock, the disease conditions can be arrested but not completely stamped out. With the least let-up in vigilance or the least unfavorable condition for inspection, these diseases may apparently flare up the next season and what was a suitable seed stock may be so infested with the virus diseases as to be unable to pass inspection.

As the certified seed stock as produced in the various States had these limitations, experimental work was undertaken at Michigan State College to determine if seed stocks free from serious virus diseases could be produced. In this work, it was felt that if considerable quantity of such stocks could be produced they would be especially valuable foundation material for certified seed growers. It was believed that those growers who started with seed stocks free from virus diseases could, so long as they followed the best practices, be assured that their stocks would not "run out" and should any disease creep in, it would be in such small amount that prompt roguing would handle the situation well.

Accordingly, in 1922, single tubers were selected by the tuber index method and after four years of isolation and close inspection, certain lots of potatoes were so increased that various releases were made to farmers, who have grown these until now with some lines more than 1,000 bushels exist which trace back to a single tuber from a high yielding hill.

The work, which has covered seven growing seasons, has had its ups and downs, its successes and failures. The fundamental fact which must be recognized about these seed stocks is that they have no inherent resistance to the virus diseases. The strains which have been found to be free from all recognizable forms of such diseases have been retained, and in increasing them attempt has been made to keep the various diseases from getting in. The stock is safe for increase only so long as it is handled in a way which prevents these virus diseases from getting a foot-hold. Safe isolation from other potatoes is absolutely essential for maintaining the "virus free" condition of the seed stocks.

The production of these lots was carried on largely at the Upper Peninsula Experiment Station and isolation of the various lots was obtained by using sunflowers as grown in large fields to furnish a screen to protect the various seed lots from possible ingress of plant



In yield test plot of single tuber lines of potatoes at East Lansing, Michigan, 1926. A portion of each stock is tested each year in a field apart from the increase plot to determine freedom from disease, relative yielding capacity, and behavior under general field conditions.

lice from commercial potato fields. Each year since 1922, the increases have been inspected by the writers. Out of the hundreds of lines which have been started, less than one dozen have been continued, the others having been discarded on account of disease, suspicion of disease, or suspicion of low yielding power.

As soon as any stock was known to be safe as far as virus diseases were concerned, and when sufficient quantity had been produced, this seed stock, usually in 10 bushel quantities, was released to selected applicants who agreed to increase the potatoes under the following conditions:

(1) The grower received the potatoes without charge but agreed to return, upon request, a like quantity of seed stock to the college for the use of some other grower.

(2) The grower agreed to follow definite cultural practices necessary to safeguard the crop from disease and to insure maximum yield.

(3) The grower agreed to plant the stock in an isolated field, one-fourth mile from commercial lots of potatoes, and to grow it subject to frequent inspection.

Naturally, under the variety of conditions to be found on the farm, there have been some deviations from and even some failures to carry out the program as outlined; but in the main it can be said that the growers have cooperated faithfully. Only one grower failed to give good isolation, and, since he planted the foundation seed stock adjacent to his field of commercial stock his planting became diseased and the foundation stock which was turned over to him was discarded. The cooperators who have carried the work through have found a great uniformity in plant type and almost total freedom from recognizable virus diseases, and, where the increase has been going on for two or three years, these growers are now planting their entire acreage with the elite single tuber strains and supplying their neighbors as well.

The method is slow at its start, since much tim is necessary to bring about the increase from a single tuber to a quantity practical for release to growers. This long period gives opportunity for test and retest of the safeness of the lines with respect to disease. Once with the grower, the progress is rapid for with the usual 15 or 20-fold increase, the 10 bushels originally furnished become in one year 150 or 200 bushels, thus enabling the farmer, in the ordinary scale of planting, to replace his old stock entirely. It is noteworthy that with but the single exception mentioned, every grower receiving a foundation stock is planning to grow this stock for his entire production. At the close of the second year, with this method, abundant seed stock is available for many other growers and this seed is of a value exactly equal to the grower's care and the quality of his situation for seed production. With each season, it is found that the growers are becoming more versed in the intricacies of the problem. They are becoming increasingly convinced that it is easier to start with clean seed stock and keep it clean, than to have the never-ending fight against virus diseases that is inherent in the ordinary seed stocks which are available for increase purposes.

Our experience with the production of these foundation stocks leads us to the following statements:

(1) We believe the increase to commercial size of the single tuber strains of potatoes which are free or practically free from recognizable virus diseases represents a distinctly forward step in potato seed production and the use of these increases as elite foundation stocks will be of significance to the potato certification business.

(2) With the existence of virus-free lines, the actual yielding quality of such stocks under various cultural conditions can be determined without the disturbing effect of disease.

(3) The grower engaging in the increase of these lines has the responsibility of maintaining their freedom from disease. They come to him as free from disease as present methods can make them. Any leaf roll, mosaic, streak, and the like are indications of the lack of suitable isolation or careless handling.

(4) Should a trace of disease appear, the uniformity of the stock allows its prompt detection and permits speedy elimination.

(5) A forward looking program is necessary to bring about widespread test of these lines in various States so that the merits or demerits of each single tuber line can be determined.

(6) Single tuber lines of the Irish Cobbler, Green Mountain, and

Russet Rural varieties have been in quantity increase for three years and releases have been made to growers. The work with the Bliss Triumph, Early Ohio, and Rural New Yorker varieties has not yet reached a point where release to farmers has been possible but it is expected that material will be available in 1930 or 1931.

A detailed technical account of the experimental work on the clonal lines of potatoes referred to above is now in course of preparation and this preliminary account is given to record the progress made in this investigation. All material available for release for 1929 plantings has been allotted but those interested in assignments for 1930 should apply early to J. E. Kotila, Department of Botany, East Lansing, Michigan.

CAUSES OF MORTALITY OF LAYING HENS STUDIED

Mortality Records at Michigan International Egg Laying Contest Show Most Prevalent Poultry Diseases During Six-Year Period

BY H. J. STAFSETH, BACTERIOLOGICAL SECTION AND
J. L. BOYD, POULTRY SECTION

Since the beginning of the International Egg Laying Contest at this station on November 1, 1922, complete records have been kept on mortality of the hens received, and the number of conditions or diseases which contributed to or caused death in each case. From these records, it has been possible to compile the number of deaths for each breed and variety in addition to the yearly and monthly death rates for the six-year period ending October 31, 1928. All hens which died during this period were autopsied at the department of bacteriology of this station.

Highly contagious poultry diseases have been responsible for a large number of the deaths shown in the tabulations which follow. These contagious diseases have caused some variation from the normal death rate during some of the months and years listed in the six-year period.

The number of diseases or conditions, which contributed to or were responsible for the deaths have been tabulated by years, months, and by breeds and varieties. Due to the autopsy reports showing as many as three or four maladies affecting the same hen no attempt has been made to list the exact cause of death. The number of cases of diseases and other causes of death total 1,601 for 1,445 deaths. The total number of diseases found by autopsy for the various years are shown below:

Diseases found on autopsy during six-year period

Diseases	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	Tota cases of each disease
Peritonitis	10	14	18	28	14	17	101
Sarcamatosis	7	9	10	16	20	28	90
Internal hemorrhages	10	16	13	10	16	18	83
*Fowl cholera	32	25	9	10	0	0	76
Fowl pox	10	16	9	11	12	17	75
Round worms	9	9	10	15	9	14	66
**Laryngo-tracheitis	0	0	0	2	9	54	65
*Enteritis	15	10	10	6	8	15	64
Visceral gout	12	6	5	10	14	12	59
Egg material in abdomen	5	3	10	8	12	21	59
Roup	5	10	15	4	1	20	55
Ruptured oviduct	6	10	6	11	9	10	52
Fatty degeneration of liver	9	11	7	8	6	10	51
Impaction of crop	7	5	7	11	5	10	45
*Pericarditis	0	4	6	3	12	19	44
*Diseased liver	6	8	4	4	7	8	37
Tumor	0	2	6	4	5	16	33
Leukemia	5	0	0	0	16	9	30
Tuberculosis	11	2	8	0	7	1	29
Fowl typhoid	10	8	0	4	3	3	28
Bacillary white diarrhoea	7	9	5	3	2	0	26
*Necrosis of liver	0	2	4	1	7	11	25
Tape worms	3	4	2	2	8	6	25
Leg weakness	10	8	5	0	0	0	23
Prolapse of oviduct	4	2	2	1	5	6	20
Abscess	0	2	4	1	2	4	13
Cyst of oviduct	3	2	3	0	2	3	13
Killed for cause	2	3	6	0	2	0	13
Coccidiosis	0	0	0	0	5	6	11
Ruptured liver	5	0	3	2	1	0	11
Salpingitis	0	0	0	0	4	7	11
Cannibalism	1	3	4	0	1	1	10
*Nephritis	1	1	0	2	2	4	10
Ruptured intestines	2	4	1	0	1	1	9
Anaemia	0	0	1	0	1	5	7
Hematoma	0	0	1	1	1	3	6
Stolen or unaccounted for	5	1	0	0	0	0	6
Edema of wattles	0	1	0	0	2	2	5
Pneumonia	3	1	1	0	0	0	5
Accidental	1	2	0	0	1	0	4
Colibacillosis	3	0	0	0	0	1	4
Fibrous material in gizzard	1	0	1	0	0	2	4
Heat prostration	0	0	2	0	1	0	3
Prolapse of intestines	1	0	1	0	0	1	3
Vent gleet	0	0	1	1	0	1	3
Ititis	0	0	0	1	0	1	2
Hemorrhage of comb	2	0	0	0	0	0	2
Punctured proventriculus	0	0	0	0	0	2	2
Thrombosis	0	0	0	0	0	2	2
Aspergillosis	1	0	0	0	0	0	1
Empyema (pleural)	1	0	0	0	0	0	1
Cyst on liver	0	0	0	0	0	1	1
Injury from fighting	0	0	1	0	0	0	1
Bumblefoot	0	0	0	0	1	0	1
Entero-hepatitis	0	1	0	0	0	0	1
Intussusception	0	0	0	0	0	1	1
Ruptured gizzard	1	0	0	0	0	0	1
Septicemia	0	0	0	0	0	1	1
Toxemia	0	0	0	0	1	0	1
Undiagnosed	24	19	18	16	11	6	94
Undetermined	22	16	15	11	6	7	77
Total causes and diseases	272	249	234	207	252	387	1,601
Total deaths	251	244	218	203	220	314	1,445

**Commonly known as infectious bronchitis.

*An attempt was made to identify as nearly as possible the cause of each disease, and to name the malady accordingly, as e. g., bacillary white diarrhoea, fowl cholera, etc. However, in many cases where enteritis and abnormalities of the liver, pericarditis, nephritis and other diseases were found the cause could not be ascertained.

From the foregoing table it may be noted that diseases of poultry are increasing. The last three-year period shows an increase over the first three years, and the year 1927-28 shows the highest mortality of

Summary of diseases found on autopsy by breeds for six-year period

Name of disease or condition causing death	Barred Rocks	White Rocks	Columbian Rocks	Buff Rocks	Rhode Island Reds	White Wyandottes	Buff Wyandottes	Black Orpingtons	Black Minorcas	Brown Leghorns	Buff Leghorns	Anconas	Dominiques	Barnvelders	White Leghorns	Total cases of each disease
Peritonitis	13	0	0	1	8	4	1	0	0	4	1	5	0	0	64	101
Sarcamatosis	20	1	0	1	10	3	2	0	0	3	0	2	0	0	48	90
Internal hemorrhages	24	1	0	4	6	1	0	0	0	2	0	9	0	0	36	83
Fowl cholera	16	1	0	2	6	5	2	1	0	2	0	8	1	0	34	76
Fowl pox	12	5	0	0	3	9	0	0	0	0	0	3	0	0	43	75
Round worms	8	0	0	0	1	0	0	0	0	0	0	6	0	0	51	66
Laryngo tracheitis	11	0	0	0	18	0	0	0	0	1	0	3	0	0	32	65
Enteritis	9	0	0	0	4	5	1	0	0	3	2	2	0	0	38	64
Visceral gout	13	0	0	1	9	5	0	0	0	0	0	2	0	0	29	59
Egg material in abdomen	7	0	0	0	6	0	0	0	0	0	2	2	0	0	42	59
Roup	10	0	0	0	2	0	1	0	0	1	1	5	0	0	35	55
Ruptured oviduct	6	0	0	0	4	4	0	0	0	2	1	7	1	0	27	52
Fatty degeneration of liver	14	2	0	1	3	1	0	0	0	0	0	2	0	0	28	51
Impaction of crop	7	0	0	0	3	1	0	0	0	0	0	2	0	0	32	45
Pericarditis	7	0	0	1	2	1	0	0	0	0	0	1	0	0	32	44
Diseased liver	7	0	0	0	8	0	0	0	0	0	0	0	0	0	22	37
Tumor	7	0	0	1	6	1	0	0	0	1	0	0	0	0	17	33
Lukemia	11	0	0	0	6	0	0	0	0	0	0	1	0	0	12	30
Tuberculosis	5	0	0	1	14	0	0	0	0	0	0	0	0	0	9	29
Fowl typhoid	6	0	0	0	1	2	0	0	0	1	0	6	0	0	12	28
Bacillary white diarrhoea	9	0	0	0	2	1	1	0	0	0	0	1	0	0	12	26
Necrosis of liver	6	0	0	1	3	1	0	0	0	1	0	0	0	0	13	25
Tape worms	3	1	0	0	1	0	0	0	0	0	0	0	0	0	20	25
Leg weakness	11	1	0	1	1	1	0	1	0	0	0	0	0	0	7	23
Prolapse of oviduct	4	0	0	0	1	0	0	0	0	1	0	1	0	0	13	20
Abscess	4	0	0	0	3	0	0	0	0	0	0	0	0	0	6	13
Cyst of oviduct	6	1	0	0	1	0	0	0	0	0	1	0	0	0	4	13
Killed for cause	3	0	0	0	1	0	0	0	0	0	0	0	0	0	9	13
Coccidiosis	1	0	0	0	2	0	0	0	0	0	0	1	0	0	7	11
Ruptured liver	3	0	0	0	3	0	0	0	0	1	0	0	0	0	4	11
Salpingitis	0	0	0	0	2	0	0	0	0	0	0	0	0	0	9	11
Cannibalism	0	0	0	1	1	1	0	1	0	0	0	2	0	0	4	10
Nephritis	1	0	0	0	1	0	0	0	0	0	0	0	0	0	8	10
Ruptured intestine	0	0	0	0	0	0	0	0	0	0	0	2	0	0	7	9
Anaemia	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6	7
Hematoma	1	0	0	0	2	0	0	0	0	0	0	0	0	0	3	6
Stolen or unaccounted for	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6
Edema	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5
Pneumonia	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	5
Accidental	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4
Colibacillosis	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	4
Fibrous material in gizzard	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4
Heat prostration	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	3
Prolapse of intestines	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3
Vent gleet	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
Iritis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Hemorrhage of comb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Punctured proventriculus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Thrombosis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Aspergillosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Empyema (pleural)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Cyst on liver	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Injury from fighting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bumblefoot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Entero-hepatitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Intussception	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Ruptured gizzard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Septicemia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Toxemia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Undiagnosed	16	0	0	0	12	6	2	1	4	0	0	5	0	0	48	94
Undetermined	14	1	0	1	10	4	0	0	0	1	0	7	0	0	39	77
Total diseases	303	15	0	17	169	57	10	4	5	24	9	86	2	0	900	1601

any yearly period. The heavy mortality during the last year was partly due to laryngo-tracheitis, more commonly known as infectious bronchitis. This disease alone accounts for over 20 per cent of the 1927-28 mortality, and is a comparatively new disease of poultry in Michigan.

From the figures shown it is evident that some diseases have become more prevalent during the six-year period, while others have shown a decided decrease. Diseases and causes of mortality which apparently are on the increase in prevalence are peritonitis, sarcamatosis, fowl pox, round worms, laryngo-tracheitis, pericarditis, leukemia, tumors, and egg material in abdomen. Those showing a decided decrease in prevalence are fowl cholera, tuberculosis, fowl typhoid, bacillary white diarrhoea, and leg weakness. Some of the last named diseases seem to be disappearing entirely from contest hens.

The following summary shows the prevalence of diseases and causes of death by breeds and varieties for the six year period.

The following summaries show the total number of hens of each breed and variety entered in the entire six contests. Total deaths and per cent mortality for each breed and variety for each year, and total losses and per cent mortality by months for the six-year period are also shown.

Total birds entered in contest by breeds and varieties during six-year period

Year	Barred Rocks	White Rocks	Columbian Rocks	Buff Rocks	Rhode Island Reds	White Wyandottes	Buff Wyandottes	Black Orpingtons	Black Minorcas	Brown Leghorns	Buff Leghorns	Anconas	Dominiques	Barnvelders	White Leghorns	Total birds in contest
1922-23	216	12	0	12	72	108	12	12	12	24	12	84	0	0	624	1200
1923-24....	264	12	0	0	96	60	12	0	12	24	0	84	12	0	624	1200
1924-25	204	12	0	0	132	36	0	0	0	12	12	36	0	0	756	1200
1925-26	204	0	12	12	156	0	12	0	0	12	12	36	0	12	732	1200
1926-27......... .. .	195	13	0	0	247	13	0	0	0	13	0	39	0	0	780	1300
1927-28..	195	0	0	0	195	0	0	0	0	13	26	26	0	0	845	1300
Totals...........	1278	49	12	24	898	217	36	12	24	98	62	305	12	12	4361	7400
Total deaths each breed and variety.........	266	15	0	17	156	57	9	3	5	24	7	83	2	0	801	1445
Per cent mortality each breed and variety....	20 9	30.6	0	70.8	17.4	26.2	25 0	25.0	20.9	24.5	11 3	27.2	16.6	0	18.4	19.5

Total number of birds in contest during 6 years................	7400
Total number of deaths....	1445
Per cent mortality for contest 6 years (per cent)................	19.5

This final summary shows the mortality for the various months of the year during the six-year period

Month	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	Total deaths by months	Per cent mortality each month
November	4	7	5	9	11	11	47	.63
December	8	12	21	13	10	37	101	1.36
January	10	21	19	7	11	35	103	1.39
February	19	13	12	11	13	24	92	1.24
March	30	22	*49	25	17	27	170	2.30
April	38	37	19	19	35	26	174	2.35
May	35	32	12	22	32	27	160	2.16
June	29	27	19	16	13	23	127	1.72
July	34	33	12	27	22	33	161	2.17
August	11	18	14	14	14	21	92	1.24
September	14	10	15	10	31	25	105	1.42
October	15	12	11	22	8	24	92	1.24
Date unknown	4	0	5	8	3	1	21	.28
Total	251	244	213	203	220	314	1445	19.50

*Seventeen birds disqualified, killed, and autopsied to determine cause of non-production after being in contest four months

Some of the outstanding points of the table shown above are that March, April, and May furnish the highest mortality. These three months are of course the period of heaviest egg production and it may be that intensive production lowers the disease resisting powers of the hen somewhat as well as contributing some other factors favorable for conditions causing death.

November is the first month of the contest year and shows the lowest death rate. December and January show a marked increase over November, and these months usually find more contagious diseases, such as fowl pox, laryngo-tracheitis, and roup taking their heaviest toll. It is also interesting to note that July is a high mortality month. This may be partly accounted for by July being the first real hot weather month in this state. Many hens come which have through an intensive winter and spring egg production and have developed some organic trouble, succumb at this time.

The grand total per cent mortality of 19.5 for the six-year period is of much significance. It really indicates that nearly one-fifth of the pullets die during their first year of egg production when placed under conditions primarily designed to promote high egg production.

As the hens which have been sent to these contests represent several hundred different farms during the six-year period, the 19.5 per cent mortality should be close to an average death rate in laying hens under Michigan conditions over a period of years.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.

264 Second Report of Grade Dairy Herd.

267 Michigan Weeds (only to libraries and teachers. Others 25c).

277 Studies in the Cost of Market Milk Production.

284 Some Information and Suggestions Concerning the Use of Phosphorus.

286 Studies and Cost of Milk Production—No. 2.

289 Corn Growing in Michigan.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.

80 Yellow Rocket (a dangerous weed).

83 Key to Orthoptera of Michigan.

90 Special Report of the Upper Peninsula Experiment Station.

94 The Financial History of a Twelve-Year-Old Peach Orchard.

95 Muskmelon Culture in Michigan.

98 Vinegar.

100 Soy Beans.

101 Oats in Michigan.

106 Sugar Beet Growing in Michigan.

107 Diseases of Bees in Michigan.

109 Dependable Michigan Crop Varieties.

110 Special Report of the Upper Peninsula Experiment Station.

111 Studies in City Milk Distribution.

119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.

120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.

122 Improvement of the Farm Woodlot.

123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management for Commercial Apiaries.
136 The Muck Soils of Michigan.
138 Rural Highways.
139 Tourist Camps.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
148 Some Important Grape Insects.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs for Landscape Planting in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.

163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
168 The Management of Michigan Muck Soils for Onion Production.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
***171 Farmers' Co-operative Buying and Selling Organizations in Michigan.**
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
***174 Spraying Calendar.**
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
178 Michigan Raspberry Diseases.
179 Forest Insurance and Its Application in Michigan.
***181 A Study of Town-Country Relationships.**
182 Strawberry Growing in Michigan.
186 Chrysanthemum Breeding.

Circular Bulletins—

34 More Wheat for Michigan.
47 Poisoning from Bacillus Botullinus.
48 Spraying for Hopperburn.
49 The Hessian Fly.
50 Hairy Vetch.
53 Standard Fertilizers for Michigan.
55 Lime Requirement for St. Joseph County.
56 Lime Requirement for Cass County.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.
Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).
*Bulletins listed in bold faced type are recent publications of this Station.

57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
67 The Cherry Maggots.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
86 Cherry Fruit Fly.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
92 Garden Flowers.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.

97 Cottage Cheese.
98 How to Make and Preserve Cider.
99 House Plants.
100 Michigan Farmers Tax Guide.
101 Cockroaches, Silver-fish, and Book-lice.
102 Farm Lease Systems in Michigan.
104 Clothes-Moths and Carpet Beetles.
105 Sweet Corn.
106 Flies Commonly Found in Dwellings.
107 Mexican Bean Beetle.

Quarterly Bulletins—

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Extension Series Bulletins—

2 The Babcock Test.
13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat.

19 Grasshopper Control.
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22 Effective Crop Exhibits.
23 Alfalfa.
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47 Buying Fertilizers.
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51 Feeding for Eggs.
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***53 Chick Diseases in Michigan.**
***54 Diseases of Adult Poultry.**
55 Plowing for European Corn Borer Control.
57 Lime for Michigan Soils.
58 Culling the Farm Flock.
59 Methods of Control for the European Corn Borer.
60 Insect and Disease Control in the Home Orchard and Vegetable Garden.
64 Cherry Production in Michigan.

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66 Why A Cull Apple is a Cull.
68 A 10' x 12' Portable Brooder House.
69 A Simple Electric Water System.
***71 Wiring the Farmstead.**
***72 Value and Care of Farm Manure.**

Club Bulletins—

2 Potato Club Work.
3 Bean Club Work.
5 Pig Club Work.
7 Corn Club Work.
9a Clothing Club Work.
10 Canning Club Work.
11 Handicraft Club Work.
12 Hot Lunch Club.
16 Michigan Club Songs.
17 Dairy Club Work.

Technical Bulletins—

21 How Contact Insecticides Kill.
32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
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48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.
62 Some Physical and Chemical Properties of Several Soil Profiles.
64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.

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66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
67 Investigations on the Blackleg Disease of Potato.
68 Bacterium Pullorum.
69 The Fruiting Habits and Pruning of the Concord Grape.
70 The Nutrient Requirements of the Strawberry.
71 Growth of Lettuce as Influenced by Reaction of Culture Medium.
72 Potato Spraying and Dusting Experiments in Michigan.
73 Adsorption by Activated Sugar Charcoal.
74 Effect of Nutrient Conditions on Colloidal Properties of Certain Vegetable Crops.
75 Influence of Nutrient Supply on Earliness of Maturity in Cabbage.
76 Concentration of Materials and Rates of Application in the Control of Apple Scab.
77 The Influence of the Reaction of Cultural Medium on the Growth of the Strawberry Plant.
78 The Effect of Certain Nutrient Conditions on Activity of Oxidase and Catalase.
79 Tests for Incipient Putrefaction of Meat.
80 Virus Diseases of Raspberries.
81 Storage and Transportational Diseases of Vegetables Due to Suboxidation.
82 Commercial Casein.
83 A Study of the Sanitary Significance of Air in Relation to Ice Cream.
84 Clarifiers and Filters in Processing Milk.
85 Studies in the Etiology of Roup and Allied Diseases.
86 The Relation of Milk Solids Not Fat to Overrun and Quality of Ice Cream.
87 Paper Wrappers and Their Effect Upon Physical and Chemical Properties of Horticultural Products.
88 Investigations on Winter Wheats in Michigan.
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91 Taxes on Michigan Rented Farms.

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Mason, M. F., M. S.	Res. Assoc. in Chem.
Thrun, W. E., Ph. D.	Res. Assoc. in Chem.
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Dibble, Charles B.	Monroe Corn Borer Station
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Lill, J. G., M. S.	Res. Asst. in Crops
Pettigrove, H. R., B. S.	Res. Asst. in Crops
Megee, C. R., M. S.	Res. Assoc. in Crops
Moore, H. C., B. S.	Res. Assoc. in Crops
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Toenjes, W.	Res. Asst. inHort.
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Spurway, C. H., M. S.	Res. Assoc. in Soils
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Tyson, James, B.S., Chilean Nitrate Co.	Fellowship in Soils
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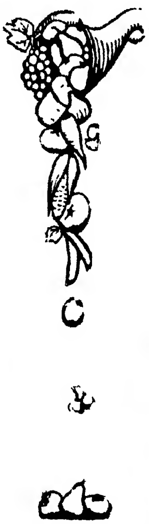
Bogue, M. V.	Bulletin Clerk

SUB-STATIONS

Chatham, Alger County, 780 acres deeded. G. W. Putnam, Director.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded. S. Johnston, Supt.
Graham Station, Kent Co., 80 acres donated by R. D. Graham; 50 acres purchased. H. M. Wells, Supt.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

THE QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science



East Lansing, Michigan

VOL. XI MAY, 1929 NO. 4

ISSUED DURING

FEBRUARY, MAY, AUGUST, AND NOVEMBER

CONTENTS

EDITED BY

V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE AGRICULTURAL EXPERIMENT STATION

DO YOU WANT FUTURE ISSUES OF THIS BULLETIN?

The mailing list for the Quarterly Bulletin is being revised, and, if you have not already asked that your name be retained on the list, you should do so if you wish to receive the latest reports on research and experimental work at Michigan State College, as published in this bulletin.

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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. 11, No. 4, May, 1929

INFECTIOUS ABORTION OF CATTLE IS VERY COSTLY

Proper Methods Reduce Danger of Infection and Furnish Measures for Reducing Losses

E. T. HALLMAN, ANIMAL PATHOLOGY SECTION

The Chief of the United States Bureau of Animal Industry has recently estimated that infectious abortion is causing an annual national loss of fifty million dollars. We have no definite information of the actual loss in Michigan. However, an effort has been made to estimate the percentage of reacting cattle in the State. This estimate is based on the results of the test of blood samples sent to the Michigan State College bacteriological laboratory during the past 10 to 12 years. Doctor Huddleson who has had charge of making these tests up until the last two years informs me that the percentage of reacting samples during this period has varied from 29 per cent to 35 per cent annually.

An attempt has been made by several experiment stations to estimate the economic loss per cow due to infection. The data submitted by the Storrs Connecticut Station estimates the loss per cow at the lowest figure of any of the estimates that have come to my attention. Their estimate is based on a study of two groups of cows, covering a period of eleven years, one of the groups reacted to the abortion test and the other did not react. These data indicate that the reacting cow produced annually $44.01 less in products than the non-reacting cow, divided as follows: loss in milk products, $28.41; loss in calves and depreciated value of cow, $15.60.

The U. S. Department of Agriculture estimates the number of dairy cows and heifers over two years of age in Michigan on January 1st, 1926 at 858,000. Assuming that 15 per cent of them, instead of 29 per cent to 35 per cent, are reactors to abortion tests, and figuring the annual loss per cow at $44.01, it is estimated that infectious abortion is causing an annual loss to Michigan dairymen of $5,664,000.

The actual loss to Michigan dairymen may be less or more than the estimated amount. The estimate indicates that infectious abortion is an important factor in affecting the profits of dairy production in this State. If certain well known facts are applied in the management of

the herd, the introduction of the disease into non-infected herds may be prevented and the infection may be eliminated from diseased herds.

The following outline has been prepared with the hope that it will aid breeders in preventing the loss due to this disease.

Loss Prevention Methods

1. The most common form of infectious or contagious abortion is a disease caused by the Bang abortion germ. Occasionally, abortions may be caused by other germs. It is doubtful if barnyard accidents ever cause abortion in cattle.
2. When one or more abortions occur in a herd, the owner should assume that the condition is infectious abortion unless subsequent tests prove that it is not.
3. The two organs in the cow to which the germ does the greatest damage are the udder and the pregnant womb. A cow may have the germ in the udder and not in the womb, she may have the germ in the womb and not in the udder, or she may have the germ in both the udder and the womb.
4. The Bang abortion germ may occasionally establish itself in the testicles of the bull and cause disease.
5. This disease is most frequently introduced into clean herds through the purchase of infected animals. Mature animals from infected herds are more apt to be infected than young, growing animals under one year of age. The germ has been found occasionally in the udders of heifers before they became pregnant. The disease may be introduced into clean herds by permitting infected cows to be brought to the farm to be bred. This may be brought about by discharge from the infected cows reaching susceptible cows in the clean herd. The disease may be introduced into herds through the use of living virulent abortion vaccines.
6. When buying cattle to introduce into a clean herd, preference should be given to cattle under one year of age. They should always be tested for abortion disease at the time of purchase. Since a cow may not react to the blood test until from one to four months after exposure to the infection, cattle should not be purchased on the result of one test but should be purchased subject to a retest in 60 or 120 days. Occasionally, a pregnant infected cow may not react to the test until after the termination of pregnancy. For this reason, the blood test should not be wholly depended upon in the purchase of pregnant cattle. If a pregnant cow is purchased, she should be isolated until after calving and then tested.
7. A cow with an infected womb spreads the infection to the greatest extent for only a week or ten days before calving, at the time of calving, and for three or four weeks following calving. Even if a cow does not abort, if she has the infection in her pregnant

womb, she may be a bad spreader at calving time and for a few weeks afterwards at least until all discharges have ceased. If the germs are in the udder, they may pass out with the milk, but this source of spreading the infection is not as dangerous as the discharges at the time of and following calving.

8. The cow becomes infected with the germ by eating feed or by drinking water that has become contaminated with the discharges of infected cattle. Licking other cattle that are soiled with their infected discharges spreads the disease. Licking or eating the infected afterbirth or aborted calf may be the means of infection. While the bull is not a big factor in spreading the disease, a bull that reacts to the abortion test should not be used on non-infected cows.
9. In herds where an abortion occurs for the first time, the aborting cow should be immediately removed from the herd, the aborted calf and afterbirth burned or deeply buried beyond the reach of dogs, the contaminated bedding and manure burned or removed beyond the reach of other cattle, and the stall thoroughly cleaned and disinfected with a strong disinfectant. If the abortion occurs on pasture, the spot soiled with the discharges should be covered with quick or hydrated lime. Since an infected cow may not react to the test at the time of abortion, one should wait until the seventh or eighth day after abortion, then draw a blood sample from the cow and send it to the State Pathologist, East Lansing, to be tested. If the test indicates that the cow is infected with the germ, all cattle in the herd over six months of age should be tested to determine the extent of infection in the herd.
10. From this point on, no general plan can be outlined for the successful control of the infection in the herd. Each herd is an individual problem. Just what should be done will depend upon the size and value of the herd, the facilities for housing and pasturing the animals, the percentage of reacting cows in the herd, their age, production, and breeding records.
11. Repeated testing of the herd with the disposal or segregation of the reacting animals is the only available way of eliminating the infection from a herd in the shortest possible time. Whether this plan should be followed should be determined only after considering the factors mentioned under Sec. 10.

Isolation Stalls Aid Control

12. If it is impossible to carry out the above plan at once, some check may be held on the disease by isolating all cows at the time of calving and for two to three weeks thereafter. The isolated cows should be milked and fed only after the rest of the herd are attended to. Care should be exercised to prevent anything contaminated with the discharges of the isolated cows reaching the

main barn or lot used by the herd. Manure and bedding should not be placed where accessible to other cattle. The efficiency of this method of checking the spread of the infection will depend upon the extent to which the rules of sanitation and hygiene are carried out. At best, it is only an expedient to be used until a better plan can be adopted.

13. No medicine or combination of minerals is known to be effective as a remedy for abortion disease. Some cows recover from abortion disease in a comparatively short time, others remain infected for several years, and some never recover. Some apparently recover and later in life become infected again. Any animal which reacts positive to the test should be considered a potential spreader, especially at the time of calving.
14. At the present time the best that can be said about vaccination, is that it is an experiment. In some herds, it has been shown that the proper use of living cultures of the abortion germ has lowered the abortion rate, but no one has shown that the infection can be eliminated from a herd by vaccination. No one has shown that udder infection with its lowered milk production has been eliminated by vaccination. With the increasing restrictions that are being placed upon the sale of reacting animals and their products, one should be cautious in resorting to vaccination as a means of controlling the disease since this practice may result in the perpetuation of the infection in the herd instead of eliminating it.
15. If abortion or other breeding trouble occurs in a herd, a reliable veterinarian possessing adequate training and experience should be consulted.

CORN VARIETIES AND PLANTING DATES ARE TESTED

Trials Made At Monroe To Select Sorts Suitable For Corn Borer Area

BY A. R. MARSTON, FARM CROPS SECTION

That Clements White Cap, Polar Dent, M. A. C. Yellow Dent, and Duncan varieties of corn are among the most satisfactory varieties for grain purposes in southeastern Michigan, particularly Monroe County, is brought out by the results of three years of testing work at the Michigan State College Corn Borer Station at Monroe.

The tests there were planned to compare different varieties of corn and different corn planting dates under conditions where the crop was likely to be seriously infested by the European Corn Borer. The test

Table I.—YIELD OF CORN VARIETIES, MICHIGAN STATE COLLEGE CORN BORER STATION, MONROE.

These tests consisted of a total of 16 plats of each variety each season, four plats of each being planted at four different planting dates.

Variety	Bushels per acre at 14% moisture			
	1926	1927	1928	Average
Clement's White Cap	51.5	48.4	57.0	56.6
Polar Dent	44.1	50.8	46.2	47.0
M. A. C. Yellow Dent	52.2	43.5	41.0	45.6
Duncan	43.8	43.2	44.5	43.8
Golden Glow		39.2	46.0	42.6
Wisconsin Cold Resistant Golden Glow	44.1	39.7	38.8	40.8
Rustler's White Dent	37.7	33.7	37.0	36.1
Isabell's First Choice	35.8	36.2	34.1	35.3
Eight Rowed Flint		31.5	32.1	31.8
Wisconsin No. 25	29.8	30.0	35.2	31.7
Michigan Yellow Dent		32.6	29.5	31.0
Northwestern Dent	33.9	26.0	25.1	28.3
King Phillip's Flint	32.2	25.8	20.9	26.3
(1) Gridley		51.1	47.9	49.5
(2) Red Cob Ensilage	51.3	44.4	50.3	48.6
(3) Golden Glow Special	47.2	..	.	..

1. The Gridley corn is an Illinois variety. When planted early, it will mature at Monroe; but when planted late, it will not.
2. The Red Cob Ensilage has been very immature when harvested for grain, in these tests, containing such a high per cent of moisture that it would not crib satisfactorily.
3. The strain of Golden Glow which yielded well in 1926 was not available for plantings in 1927 and 1928.

consisted of 16 plats of each variety each season, four plats of each being planted at four different planting dates.

No material differences in infestation among ordinary Michigan corn varieties have been found thus far, but there were marked differences in the yields of these varieties under southeastern Michigan conditions.

The varieties yielding most, as an average for three years, were Clements White Cap, a corn bred by Paul Clement of Britton, Michigan; Polar Dent; M. A. C. Yellow Dent; and Duncan corn. The last three are varieties bred by J. R. Duncan, corn breeder at the Agricultural Experiment Station of the Michigan State College. The Polar Yellow Dent was bred by Mr. Duncan for frost resistance and this variety has been remarkably resistant to spring frosts and adverse weather conditions when planted real early. Data for the April 28th plantings show it outyielded all other varieties in bushels of sound corn per acre. The Duncan and M. A. C. are also yellow dent corns.

May 12 to 25 Best Time to Plant

The results of the influence of time of planting on infestation by the European corn borer will not be discussed in detail here. This work has been carried on in cooperation with the Entomology Section and

TABLE II.—TIME OF PLANTING TEST

Average Results for Three Year Period, 1926, 1927, 1928.

Variety	April 28			May 12			May 25			June 9		
	Yield Bu at 14% moisture	Moisture per cent at harvest	Days of growth	Yield Bu at 14% moisture	Moisture per cent at harvest	Days of growth	Yield Bu at 14% moisture	Moisture per cent at harvest	Days of growth	Yield Bu at 14% moisture	Moisture per cent at harvest	Days of growth
Clement's White Cap	41 9	45 6	135	62 8	46 7	136	56 1	44 1	131	48 6	47 7	124
Polar Dent.	46 3	45 2	141	45 2	52 2	134	59 8	45 2	129	37 0	50 1	124
Golden Glow	45 7	47 2	137	51 6	44 9	128	55 2	38 9	127	37 4	43 6	119
Duncan ...	43 3	47 4	141	47 6	48 0	133	46 0	47 5	128	38 3	43 8	117
M. A. C.	41 0	46 2	140	50 2	45 8	132	52 4	43 2	130	38 7	48 3	119
Wisconsin Cold Resistant	33 5	45 8	139	47 9	48 1	132	44 5	42 1	130	37 7	44 6	117
Wisconsin No 25	27 5	46 4	129	35 2	46 7	123	33 3	44 1	120	30 7	38 9	114
Isbell's First Choice	33 4	42 8	140	37 8	42 4	134	37 4	41 6	127	32 7	43 8	124
Northwestern Dent	27 3	45 9	135	31 9	43 8	126	27 5	49 4	121	28 7	41 0	117
Rustler's White Dent	33 9	48 5	135	41 7	46 7	130	38 0	38 7	126	31 3	46 8	117
Gridley.	53 1	48 8	153	62 9	42 0	143	49 5	47 6	143	30 1	41 8	*
Michigan Yellow Dent	26 5	43 8	138	32 8	42 6	130	35 3	34 5	125	34 7	38 4	118
Eight Rowed Flint	28 0	47 3	137	35 2	39 6	132	33 8	35 0	127	30 1	41 8	126
King Phillip Flint	23 6	45 9	136	26 0	45 6	124	31 1	31 7	123	24 7	38 9	119

*Very immature.

detailed publication of these results will probably be made at the end of next season. It is sufficient to say at this time that, with the present infestation of corn borers, no change in the time of planting practices is warranted even though late planted corn is less likely to carry a serious borer infestation.

Strictly from the standpoint of the corn itself, the work on the proper time for planting has emphasized the importance of avoiding delay in getting the corn planted in a clean, well-tilled seed bed.

From the results shown in Table II, it is apparent that the most satisfactory time to plant corn in the vicinity of Monroe is about May 12th. Corn planted on this date yielded best in the case of nine of the 14 varieties listed. In all other instances, the best yields were from May 25th plantings. These May 12th plantings not only held some advantage in yield over those of May 25th but the leading varieties. Clement's White Cap, Polar Dent, Duncan, and M. A. C., matured September 21st to 25th when planted May 12th and did not mature until October 1st to 3rd when planted May 25th.

Plantings made April 28th were much more desirable than those made June 9th. Not only were the yields greater but the grain was much better matured.

GOOD RATIONS STOP COTTONSEED MEAL INJURY

Other Concentrates Have Same Effect on Health of Cattle As Cottonseed Meal

BY C. F. HUFFMAN, DAIRY SECTION

The ration of dairy cattle in Michigan is more likely to be deficient in protein than in any other food material. This is due to the fact that most home grown grains are low in this constituent. Consequently, additional protein to meet the requirements for growth and milk must ordinarily be supplied by purchasing high priced concentrates. Cottonseed meal is usually the cheapest protein concentrate available in large quantities. About 1,600,000 tons are produced annually in this country. The protein of cottonseed meal is of high quality, since it contains all the amino acids in the proper proportions for growth and milk production. However, many dairymen are reluctant to feed cottonseed meal, especially to calves, due to the belief that it produces cottonseed meal injury.

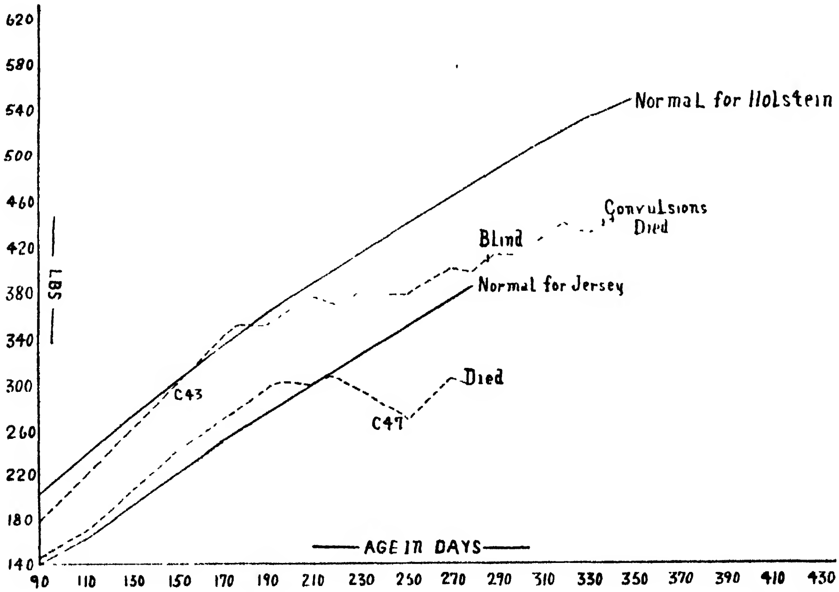

Figure 1. Growth in weight of calves receiving cottonseed meal as the chief source of protein with wheat straw as a roughage.

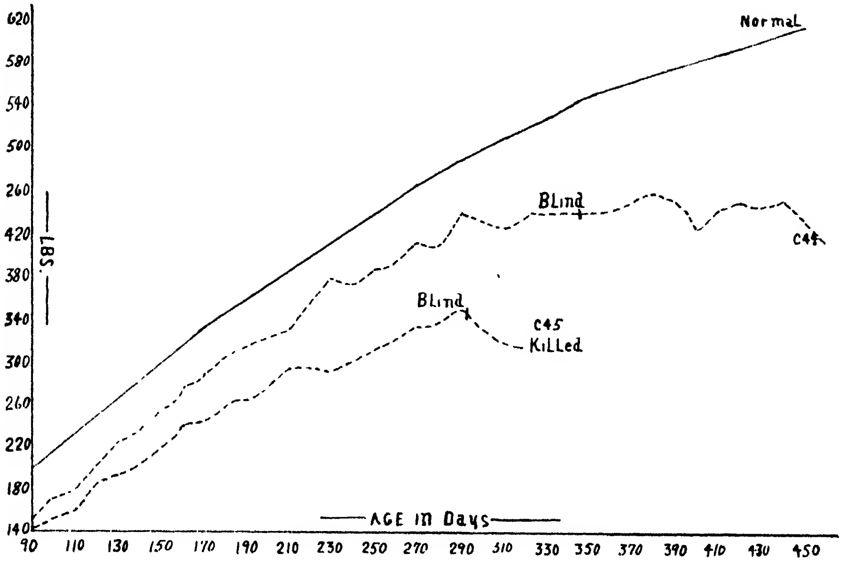

Figure 2.—Growth in weight of calves receiving corn gluten meal and corn distillers grain as the principal source of protein with wheat straw as a roughage.

The physical conditions which have been called cottonseed meal injury have been ascribed to many causes such as molds, vitamin B deficiency, iron deficiency, and the effect of gossypol. A study of the literature of cottonseed meal injury reveals that the symptoms of cottonseed meal injury in cattle are similar, if not identical, to those produced when calves are fed on concentrates alone. A study of the literature also shows that the symptoms of cottonseed meal injury have usually occurred in cattle when insufficient roughage or roughage of poor quality has been fed.

Results of an experiment at the Michigan Agricultural Experiment Station indicate that cattle cannot be grown from birth to maturity on concentrates alone. Calves fed only concentrates usually die in convulsions, which is a symptom often observed in cottonseed meal injury. In order to determine the relation of cottonseed meal poisoning in cattle to the disease produced when concentrates alone are fed, two lots of two calves each were used. The animals in Lot I, C 43 and C 47, received cottonseed meal as the principal source of protein, while those in Lot II, C 44 and C 45, received corn gluten meal and corn distillers grains. Both groups received corn and oats and wheat straw ad libitum. Salt was placed before the animals at all times. Skim milk was fed to six months of age. The animals used were four bull calves, three Holsteins and one Jersey, which had received adequate rations up to the time they were placed on experiment, which was about three months of age.

Figures I and 2 show that the gain in body weight of all four calves

was fairly good for a time. The rate of gain was more rapid and the ensuing decline greater in the case of the two animals receiving cottonseed meal than where corn gluten and corn distillers grain were fed. This was probably due to the greater palatability of the cottonseed meal which caused an increased intake of concentrates by calves C 43 and C 47. Stiffness and swelling around the hooks were observed in all four animals. C 43 had a convulsion which lasted about ten minutes when 287 days old. Seven days later another convulsion of short duration was observed. Diarrhea was also manifested from time to time. This animal was found dead on the 350th day. It probably died in convulsions. C 47 died at 275 days of age. This animal did not become blind, nor manifest convulsions, although the heavy feeding of concentrates injured its health.

Calves C 44 and C 45 became blind on a ration free from cottonseed meal. Neither of these calves died from the effects of the ration but their condition was so poor that C 45 was killed and the ration of C 44 changed.

The histopathological study of the glands and organs of calves C 43 and C 45 and C 47 made by Dr. Delez of the Department of Animal Pathology indicates that the optic nerves, kidneys, and liver are the most seriously and frequently affected organs. The evidence seemed to indicate a chronic interstitial nephritis.

It is interesting to note that the two rations which were fed brought

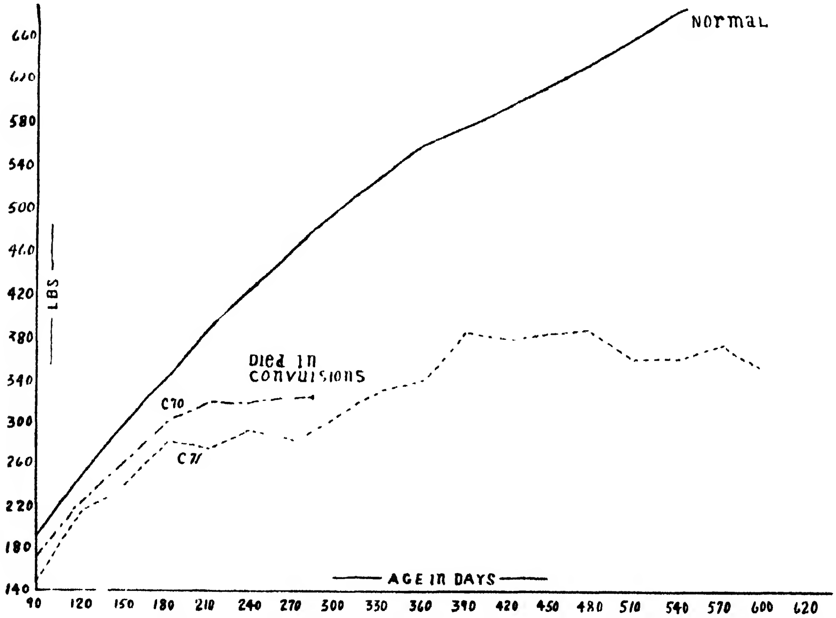

Figure 3.—Growth in weight of calf C 70 fed cottonseed meal and calf C 71 fed linseed oil meal as the principal source of protein with wheat straw as a roughage.

about similar pathological changes which indicate that cottonseed meal injury may be due to a deficiency in the ration.

The Effect of Feeding Linseed Oil Meal and Cottonseed Meal With a Poor Roughage

Two Holstein bull calves, C 70 and C 71, were placed on experiment at about three months of age. Calf C 70 was fed a ration consisting of wheat straw, corn, oats, bone meal, salt, and cottonseed meal. C 71

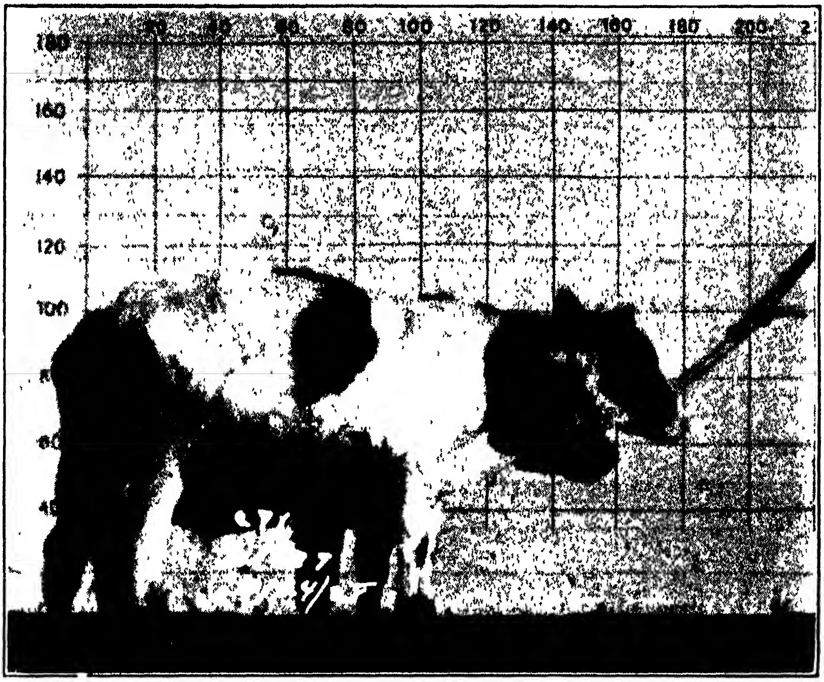

Plate 1.—Calf C 71 at 583 days of age. Ration: linseed oil meal, corn, oats, bone meal, salt and wheat straw.

received the same ration except old process linseed oil meal was fed in place of cottonseed meal. Both animals received skim milk until five months of age. The growth records are shown in Figure 3.

C 70 which received cottonseed meal died as a result of a convulsion when 301 days old. C 71 which received linseed oil meal failed to manifest convulsions. However, the growth curve shows that it failed to grow normally. As a matter of fact, this calf did not grown after it was 390 days old. During the last four months of the experiment, it gradually lost weight. The addition of cod liver oil at 547 days of

age failed to bring about recovery. This animal became so weak and emaciated that it was removed from the experiment at 600 days of age.

The Effect of Feeding Cottonseed Meal with Good Hay and Silage

The results with calves, C 43, C 44, C 45, C 70, and C 71, indicated that the cause of cottonseed meal injury in cattle may be due to a deficiency in the ration brought about by feeding roughage of poor quality. In order to determine the effects of feeding cottonseed meal

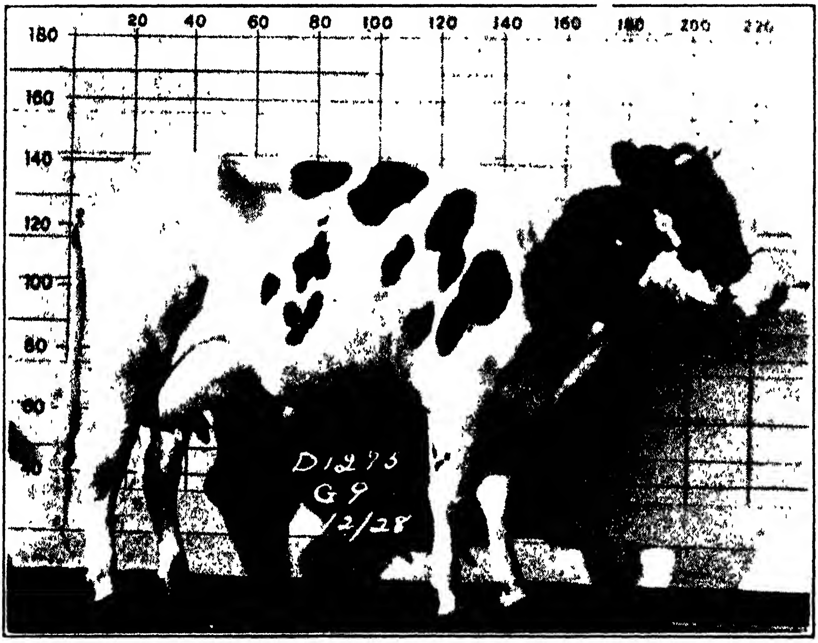

Plate 2.—G 9 at two years of age. Principal source of protein: cottonseed meal.

in reasonable amounts with ample roughage of high quality, ten grade Holstein heifer calves were placed on experiment at about three months of age. These animals were divided into two lots of five heifers each. The inheritance of the animals in both lots was similar. The dams of all the animals used in this experiment were related. Animals in Lot I received cottonseed meal as the principal source of protein. Those in Lot II received linseed oil meal as the principal source of protein. The latter lot was used as a check since linseed oil meal is recognized as a safe protein concentrate to use as a supplement for dairy calves.

Rations: Both lots received skim milk until about 150 days of age. They were also fed throughout the experiment all the timothy hay and corn silage which they would clean up. Bone meal was fed as 2 per cent of the protein concentrate to both lots of heifers. They were allowed free access to salt. Yellow corn was fed in order to equalize total digestible nutrients. The animals in Lot I received 0.5 pounds of cottonseed meal per day until 150 days of age, after which enough cottonseed meal was fed to meet the protein requirement according to Armsby feeding standard, which was 2.4 pounds per day. The protein furnished in the roughage and corn was allowed as excess protein.

Old process linseed oil meal was fed to the animals in Lot II as the

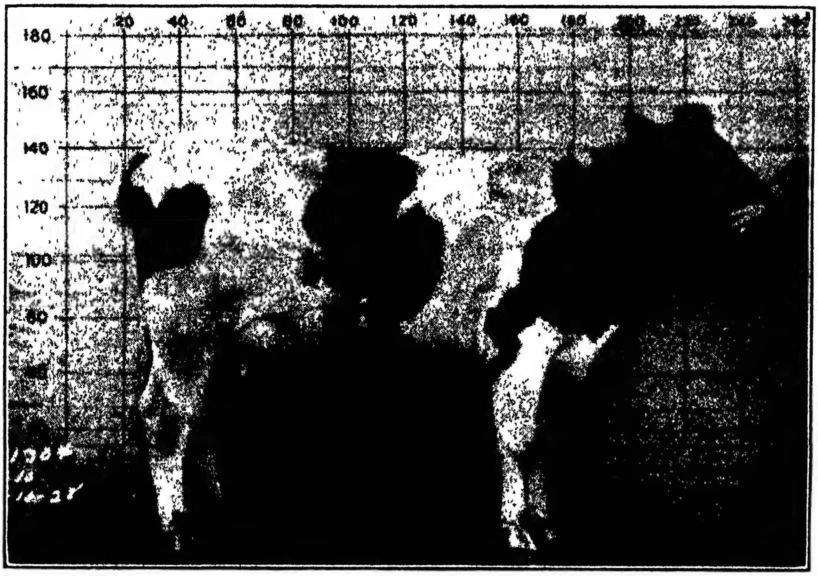

Plate 3.—G 10 at two years of age. Principal source of protein: linseed oil meal.

chief source of protein supplement. These heifers were fed 0.7 pound daily until 150 days of age, after which the intake was gradually raised to three pounds of linseed oil meal per day.

Health: There has been but very little difference in the health of the two lots of heifers thus far. The animals which received 2.4 pounds of cottonseed meal daily from five months to 24 months of age failed to show swollen joints, stiffness, blindness, emaciation or convulsions which are the symptoms of cottonseed meal injury. The animals in both groups were all above normal in weight at 24 months of age.

Hide and Hair: It is common opinion among live stock feeders that the feeding of linseed oil meal to cattle results in a sleeker coat of hair and a more pliable hide than when cottonseed meal is fed. However, in this investigation there was no appreciable difference between the sleekness of coat, pliability of hide, and condition of the animals fed linseed oil meal and those fed cottonseed meal.

This experiment is being continued in order to determine the effects of heavy cottonseed meal feeding on reproduction and milk production of dairy cattle over a period of three generations.

Summary

There appears to be a close relationship between the symptoms of cottonseed meal injury in cattle and the injury prod ced when too much concentrates are fed in proportion to roughage. Convulsions, stiffness, and blindness which are the common symptoms of cottonseed meal injury in cattle are also manifested when the ration contains a considerable amount of concentrates and little or no hay or grass.

The present results suggest that cottonseed meal may be fed to growing calves without injury when the ration is otherwise adequate. At least two pounds of cottonseed meal daily can be fed to calves five months of age or older which receive all the silage and hay of good quality they will clean up.

There is no appreciable difference in the sleekness of coat and pliability of hide between the heifers receiving cottonseed meal and linseed oil meal.

ESSENTIAL FACTORS IN CLEAN MILK PRODUCTION

Bacterial Count in Milk Is Reduced By Simple Precautions

BY G. MALCOLM TROUT, DAIRY SECTION

A series of experiments were conducted at the Michigan State College to compare the relative importance of several factors in the production of clean milk of high keeping qualities.

Five trials were made on each of five factors studied. The results secured in the study of each factor follow:

I. Open versus Small Top Milk Pail

In this experiment, cows having unclipped flanks and unwiped flanks and udders were used. The milk was drawn in one case into a sterile open pail and in another case into a sterile small top pail. One sample of milk from each lot was plated on standard media to obtain the bacterial content while a second sample was incubated at 70° F. and the type of fermentation noted. The results obtained are presented in the following table:

Table I.—The number of bacteria and type of fermentation in milk drawn into an open pail as compared to that drawn into a small top pail.

Trial No.	Open top pail		Small top pail	
	Bacteria per cc.	Fermentation	Bacteria per cc.	Fermentation
1	10,000	Slightly gassy	1,300	Slightly gassy
2	64,000	Very gassy	55,000	Slightly gassy
3	24,800	Very gassy	2,000	Clean
4	14,000	Very gassy	3,500	Slightly gassy
5	1,000	Slightly gassy	2,400	Slightly gassy

II. Sterile vs. Unsterile Utensils

Small top pails were used in this experiment. The cow's flanks and udder had been clipped and, just previous to milking, were curried and wiped with a damp cloth. Conditions about the cow and milker were as clean and sanitary as possible. One pail was sterilized while the other had been rinsed following previous milking but was not sterilized. The results obtained are presented in Table II.

Table II.—The number of bacteria and types of fermentation in milk drawn into a sterile and into an unsterile milk pail.

Trial No.	Type of pail	Condition of pail	No of bacteria per c c	Type of fermentation	Condition of pail	No. of bacteria per c.c	Type of fermentation
1	Small top	Unsterile	25,000		Sterile	3,000	
2	Small top	Unsterile	34,000	Gassy	Sterile	1,000	Slightly gassy
3	Small top	Unsterile	2,550	Gassy	Sterile	400	Clean
4	Small top	Unsterile.	800	Gassy	Sterile	500	Clean
5	Small top	Unsterile.	100,000		Sterile	2,000	Slightly gassy

III. Discarding Strippings

The first three to five streams of milk from each teat were milked into a separate container and kept separate from the rest of the milk. The regular milking was done in a sterilized small top milk pail. Samples of each lot were plated out and incubated and the resulting growth and fermentation noted. These results are to be found in Table III.

Table III.—The effect upon the bacterial count of the milk by discarding the first few streams of milk.

Trial No.	Bact per c.c in fore milk	Bact per c c in after milk	Bacterial reduction
1	3,000	600	2,400
2	2,200	800	1,400
3	2,600	550	2,050
4	8,100	1,900	6,200
5	3,600	600	3,000
Average	3,900	890	3,010

IV. Development of Acid When Milk Was Held at Different Temperatures

A sample of raw milk was divided into two lots one of which was held at 40° F. while the other was held at 70° F. During the first day the acidity was taken at intervals of three hours and once a day thereafter for seven days. The effect of temperature upon the "souring" of milk is shown in the following table:

Table IV.—The effect of temperature upon the acid development in milk.

Time	Average 5 trials	
	Acidity at 40°F per cent	Acidity at 70°F per cent
0 hour	.17	.17
3 hours	.18	.20
6 hours	.18	.34
24 hours	.18	.74
2 days	20	85
3 days	.20	87
4 days	21	92
5 days	22	95
6 days	.24	.. ..

V. The Effect of Method of Cooling Upon the Rate of Cooling and the Final Temperature of the Milk

1. **Cooling in Tank—Stirred and Unstirred:** Two five-gallon cans of milk were placed in a tank of cold water having a temperature of 52° F. One can was stirred every 15 minutes while the other was kept unstirred. The results secured are given in Table V.

Table V.—Effect of stirring upon the time and temperature of cooling.

Time	(Average 5 trials) stirred temperature	Not stirred
0	93°F	93°F
30 min	67°	76 5°
1 hr – 30 min.	55 5°	66°

2. **Cooling Over Surface Cooler:** The surface cooler used consisted of the corrugated type in which the circulating water forms a continuous sheet from the intake to the outlet. The temperature of the water was 52° F. The milk was allowed to flow freely over the surface in the first part of the experiment and was retarded by closing the faucet half way during the last part. The temperatures recorded are given in Table VI.

Table VI.—Effect of rate of milk flow over the surface cooler upon the final temperature.

Initial temp 93°F	(Average 5 trials)	
	Temp. faucet full open	Temp. faucet half open
	59°F	52°F

3. **Cooling in Air:** Six five-gallon lots of milk were set outside at the corner of the building where there was maximum air circulation. In every case, the temperature of the air was below freezing while in one trial the temperature of the air was below zero. The temperatures of the milk recorded after exposure to these low temperatures are given in Table VII.

Table VII.—The cooling effect of air upon milk.

Time	Temperature
0	93°F
30 min	86°F
1 hr. 30 min	74°F

VI. Summary

1. The use of the small top milk pail excludes a great percentage of dirt-bearing bacteria thereby resulting in a milk of a lower bacterial content showing natural fermentation or souring.
2. Unsterile utensils represented the greatest source of contamination. When the utensils were sterile and the flanks and udder were clipped and free from dirt, milk having a low bacterial count and showing normal souring without gas production was produced.
3. Discarding the first few streams of milk from the regular milking reduced the initial bacterial count about 75 per cent. When a high grade milk, such as certified or special, is being produced this factor is of great importance in keeping the bacterial content down.
4. The bacteria in milk which had been cooled below 50° F. grew very slowly as shown by the acid production. However, when the milk was held at 70° F. enough acid was produced within 24 hours to sour the milk and render it unsalable as market milk.
5. Surface cooling was the quickest and most efficient method of cooling milk. When the milk was allowed to flow slowly over the surface, greater cooling was encountered. Tank cooling in which the milk was stirred at 15 minute intervals resulted in cooling the milk satisfactorily within two hours. However, when the milk was not stirred, the temperature was not sufficiently low to inhibit rapid bacterial growth at the end of the two hour period. Cooling milk in the air was very slow and inadequate and is not recommended.

TRIALS IN FINISHING WESTERN LAMBS REPORTED

Results Indicate Some Rations Reduce Cost of Gains and Give Animals Better Finish

BY G. A. BROWN AND G. A. BRANAMAN, ANIMAL HUSBANDRY SECTION

One hundred six western feeding lambs averaging 63 pounds in weight were purchased on the Chicago market October 8, 1928, costing $13.00 per cwt. at Chicago. The lambs arrived at the College October 9 and one lamb died from pneumonia the following day. The remaining 105 lambs were weighed and divided into seven lots of 15 lambs each. All lots were fed a small amount of corn and oats and all the clover hay they would eat until October 30. They were then weighed on three consecutive days and some lambs changed to other lots. In dividing the lambs into seven lots, the weight, form, condition, quality, and feeding capacity of the lambs as indicated in the preliminary period of three weeks were carefully considered in order to have the lots as nearly equal as possible.

The object of this test was to study the comparative feeding value of:

1. Corn versus barley. Lots 2 and 6.
2. Corn versus oats. Lots 2 and 7.
3. Barley versus oats. Lots 6 and 7.
4. Alfalfa hay versus silage and alfalfa. Lots 1 and 2.
5. Linseed meal versus no protein supplement. Lots 2 and 3.
6. Alfalfa hay versus stover and alfalfa, both with silage. Lots 3 and 4.
7. Shock corn versus shelled corn and corn silage. Lots 3 and 5.

Rations fed:

Lot 1. Alfalfa hay, shelled corn.
Lot 2. Alfalfa hay, shelled corn, silage.
Lot 3. Alfalfa hay, shelled corn, silage, linseed meal.
Lot 4. Alfalfa hay, shelled corn, silage, linseed meal, corn stover.
Lot 5. Alfalfa hay, linseed meal, shock corn.
Lot 6. Alfalfa hay, silage, barley.
Lot 7. Alfalfa hay, silage, oats.

First cutting alfalfa hay was fed during the first four weeks after which the lambs were gradually changed to second cutting alfalfa hay.

At the beginning of the experimental test, each lot of fifteen lambs was receiveing five pounds of grain and 28 pounds of alfalfa hay daily. The grain allowance was increased gradually until November 25 when each lot of lambs was receiving 20 lbs. of grain daily or 1 1/3 pounds daily per head.

The lots which were fed silage received similar amounts of silage and it was increased at the same rate as was the grain allowance. The hay allowance was reduced as the silage and grain were increased. No change in the amount of silage or grain fed was made between November 25 and December 8. Between December 8 and December 18 the grain and also the silage allowance was increased from 20 to 25 pounds per lot or from 1 1/3 pounds per head daily to 1 2/3 pounds per head daily. This allowance proved to be too much for Lot 1 which received shelled corn and alfalfa hay, and also for Lot 2, which were fed shelled corn, alfalfa hay, and corn silage. Both lots went off feed and 10 days were required to get them back to a full feed.

SUMMARY OF RESULTS

15 lambs per lot—80 days—October 30, 1928-January 18, 1929.

	Lot I	Lot II	Lot III	Lot IV	Lot V	Lot VI	Lot VII
Ration	Shelled corn, alfalfa	Shelled corn, alfalfa, silage	Shelled corn, alfalfa, silage, linseed meal	Shelled corn, alfalfa, silage linseed meal, corn stover	Shock corn, alfalfa, linseed meal	Barley, alfalfa, silage	Oats, alfalfa, silage
No. of lambs	15 lbs	15 lbs.	15 lbs	15 lbs	15 lbs.	15 lbs	15 lbs.
Av. initial wt	65 5	66 1	66	66 1	66 3	65 9	66
Av. final wt	89 00	89	95 5	93 4	92 3	92 8	92 1
Av gain per lamb	23 5	22 9	29 5	27 3	26	26 9	26 1
Av daily gain	293	286	368	342	325	337	327
Av. daily ration:							
Shelled corn	1 241	1 195	1 531	1 152			
Linseed meal			.165	165	241		
Alfalfa	1 762	1 48	1 478	484	987	1 541	1 503
Corn silage		1 149	1 355	1 354		1 356	1 356
Corn stover				2 47			
Shock corn					3 383		
Oats							1 318
Barley						1 318	
Feed per 100 lbs gain.							
Shelled Corn	423 30	418 07	313 08	337 3			
Linseed meal			44 73	48 18	74 03		
Alfalfa hay	600 85	517 78	401 24	141.7	303 84	457 67	471 68
Corn silage		402 04	367 87	396 34		402 72	414 80
Corn stover				724 39			
Shock corn					1041 00		
Oats							403.44
Barley						391 46	
*Feed cost per 100 lbs gain	$11 02	$11 43	$10 04	$10 88	$11 15	$10 60	$10 93
Initial cost per cwt. in lots	14 00	14 00	14 00	14 00	14 00	14 00	14 00
Initial cost per lamb in lots	9 17	9 25	9 24	9 25	9 28	9 23	9 24
Feed cost per lamb	2 58	2 61	2 96	2 97	2 90	2 86	2 86
Cost of lamb plus feed cost	11 75	11 86	12 20	12 22	12 18	12 09	12 10
Necessary selling price in feed lots to break even	13 20	13 325	12 77	13 08	13 20	13 03	13 14
†Selling price in lots	15 11	15 12	15 25	15 20	15 12	15 16	15 05
Selling price per head	13 45	13 46	14 56	14 20	13 94	14 07	13 86
Returns per lamb above feed cost	1 70	1 60	2 36	1 98	1 76	1 98	1 76

*Prices of feeds: All grain $1 75 per cwt. (corn 98c per bu., barley 84c, oats 56c), shock corn $14 per ton, linseed meal $55 per ton, alfalfa hay $12 per ton, corn stover $5 per ton, silage $5 per ton.

†Selling price in Detroit, $16.75, marketing cost and shrink (4 lbs. per lamb) $1.50. Selling value in lots $15.25 except thin lambs at $14.50 as follows: Lot 1-3 lambs, lot 2-3 lambs, lot 3, none, lot 4-1 lamb, lot 5-3 lambs, lot 6-2 lambs, lot 7-4 lambs.

The grain ration fed to Lots 3 and 4 consisted of seven parts shelled corn and one part linseed meal.

Lot 5 was fed a sufficient amount of shock corn to give them the same amount of corn as Lot 4 received.

Conclusions

1. Lot 6, receiving barley, and Lot 7, receiving oats, consumed more feed, gained more rapidly, required less feed per hundredweight of gain, and returned 38c more per lamb above feed costs in the barley lot and 16c in the oat lot than did Lot 2 receiving corn. Apparently, the higher protein content of barley and oats gives them some advantage over corn when silage is being fed without a protein supplement.

2. The lambs receiving barley in Lot 6 made slightly more gain than those receiving oats in Lot 7. This increased gain was made on practically the same amount of feed, which resulted in a cheaper cost per hundredweight of gain and 22c more return per lamb above feed cost.

3. The addition of corn silage, in Lot 2, to the corn and alfalfa ration, fed Lot 1, reduced the gains slightly and increased the cost of gains, resulting in 10c less return per lamb above feed cost. Both these lots of lambs were delicate in their appetites and went off feed easily. Neither lot received any protein supplement.

4. The addition of linseed meal, in Lot 3, to the corn, silage, and alfalfa ration which was fed Lot 2 resulted in greater feed consumption, more rapid gains, $1.39 lower feed cost per hundredweight of gain, and a return of 76c more per lamb above feed cost. This lot was decidedly the most profitable lot in the experiment. All lambs in this lot were well finished.

5. Substitution of corn stover, in Lot 4, for two-thirds of the alfalfa hay which was fed Lot 3 reduced the gain, increased the cost per hundredweight of gain 84c, and reduced the return per lamb above feed cost 38c.

6. Substitution of shock corn, in Lot 5, for the shelled corn and corn silage in the ration fed to Lot 3 resulted in a smaller gain, a higher cost per hundredweight gain by $1.11, and 60c less return per lamb above feed cost, even though the lambs received considerably more linseed meal than the silage fed lambs.

Note: These data are the result of one feeding trial only. Further data will be necessary before final conclusions are drawn.

FOUNDATION COW BUILDS UP CHATHAM HERD

Thirty-seven Females Are Decendants of Cow Purchased in 1915

BY G. W. PUTNAM, UPPER PENINSULA EXPERIM' NT STATION

In 1915 members of the Dairy Department of Michigan State College were commissioned to gather a foundation herd of Holstein-Friesians to put on the Upper Peninsula Experimental Substation at Chatham in Alger County. This foundation herd was gathered from the herds of Arthur Wigger, Zeeland, Michigan; Browning and MacPherson, Howell, Michigan; and from the College herd at East Lansing. Of the 11 cows in the original herd, two died within three months after being moved into the Upper Peninsula. Among the cows that came from Browning and MacPherson at Howell was Beauty Pietertje Segis De Kol and her offspring, a heifer calf dropped by her as a two-year-old. This mother and daughter are still in the herd and are the only survivors of the original herd established in 1916.

Beauty Pietertje Segis De Kol, or number nine, as she is recorded in our herd book, was not a remarkable cow, judged from a production standpoint; in fact she was very ordinary. As a two-year-old, she made an official seven day record of 367.5 pounds of milk and 14.184 pounds of butter. As a sixteen-year-old cow with only three-quarters, she made in the Holstein-Friesian Herd Test a record of 10,535 pounds of milk and 345.48 pounds of fat in 289 days. In the four years of C. T. A. work finished in May 1928, her average was 8,413 pounds of milk and 264 pounds of butterfat. She was 11 years old when she started in C. T. A. work and then she was a three-quarters cow. When in her prime from five to 10 years of age, she was not tested although her milk record is available, and we find that as a seven-year-old she gave 15,184 pounds of milk and during the six-year period her lowest record was 10,240 pounds of milk. In the four years that she was in C. T. A. work her average butterfat test was 3.04 per cent. Thus, if she is credited with producing three per cent milk, it is found that, in her prime, she produced 455.52 pounds of fat during her best year. Her individual record is summarized in Table I.

Briefly, the record is that of an unusually consistent breeder, 14 living calves to her credit from the time she was a two-year-old until her sixteenth year, and not a slip in her yearly production record until she was 13 years old. At the time this was written, she was again safe in calf and in good physical condition. From the standpoint of the Experiment Station, it is unfortunate that eight of her 14 calves were males, but when considered from the standpoint of Upper Peninsula farmers it is probably a good thing, for these eight males were

Table I.—Production record of Number 9, born January 10, 1913.

Date calved	Lbs. of milk	Lbs. of butter fat calculated at 3 per cent	Sex of calf	Eartag No.
March 30, 1915	*		Female	18
February 3, 1916	7,068	212 04	Female	24
January 21, 1917	9,292	278 76	Female	28
December 10, 1917			Female	36 } twins
			Female	37 } twins
December 9, 1918	12,117	363 51	Male	H.B. No. 256575
October 24, 1919	12,706	381 18	Male	H.B. No. 329926
1920	15,184	455 52		
January 8, 1921	13,915	417.45	Male	115
December 21, 1921			Male	120
December 18, 1922	11,414	342.42	Female	78
1923	10,240	307 20		
March 26, 1924	10,705	321 15	Male	131
August 2, 1925	6,640	199.20	Male	138
1926	3,883	116 49		
February 11, 1927	12,546	376 38	Male	145
March 5, 1928	11,456	343 69	Male	203

*Milk record not available.

sold to Upper Peninsula dairymen and directly and indirectly have helped to build up a number of herds. It is also unfortunate from the standpoint of the Station that two or her six heifer calves were sold and that one died as a two-year-old. The remaining three, however, have made a valuable contribution to the herd. At this writing, there are 37 females in the herd, of which 26 are direct descendants of Number 9. In addition, there are some females which have been sold but which have left their off-spring in the herd. The production record of each of the females in this line is available but space will not permit presenting them in detail. However, Table II presents the two-year-old records of all females of this line. To say the least, they are far above the general average for the State and reflect credit on their maternal ancestor, Number 9. When considered along with the uni-

Table II.—Records of daughters of Number 9 as two-year-olds. (Lactation Period)

Cow number	Pounds of milk	Average test	Calculated butter fat (pounds)
18	10,461	3 00	313 83
37	14,558	2 81	409 08
41	13,733	2.59	355 68
50	15,205	2 50	380.13
64	10,433	2 96	308 82
66	12,313	2 68	329.99
76	9,798	2 88	282.18
78	10,255	3 16	324 06
82	11,433	3 26	372.72
84	11,778	3.00	353 34
*89			
153	8,311	3 25	270 01
161	6,946	3 20	222.27
166	9,364	3 00	280.92
164	7,628	3.00	228.84
167	10,318	3.13	322.80

*Sold soon after calving, no record

form hardihood and rugged constitution that has characterized all of this progeny, even though some are great-great granddaughters, they serve to afford some measure of the contribution that a single individual may sometimes make to a herd when her good qualities are fully capitalized.

The Sire's Influence

A casual study of these records, however, might leave the impression that there is no continuity to the different generations of females involved. However, if the whole story is told the sires of these cows must be considered. Table III shows the relation of sire to daughter.

Table III.—Records of daughters of Number 9, grouped .o show the influence of their sires.

Sire's name and number	Daughter's number	Milk production pounds	Average test	Calculated butter fat pounds
College Forbes De Kol, H B No 111266	18	10,461	3 00	313 83
Emblagaard Colantha Ladoga, H. B. No. 132103	37	14,558	2 81	409 08
	41	13,733	2 59	355 68
Average		14,145	2 70	382 38
Emblagaard Colantha Bonastine, H B No 263137	50	15,205	2 50	380 13
	64	10,433	2 96	308 82
	66	12,313	2 68	329 99
	84	11,778	3 00	353 34
Average		12,432	2 78	343 07
Canary Segis Beets, H. B. No 237625	76	9,798	2 88	282 18
	78	10,255	3 16	324 06
	82	11,433	3 26	372 72
	153	8,311	3 25	270 01
	161	6,946	3 20	222 27
	166	9,364	3 00	280 92
Average		9,351	3 13	292.03
Chatham De Kol Longfield, H. B. No. 457687	164	7,628	3 00	228 84
Chatham Segis De Kol, H. B. No 449591	167	10,313	3 13	322 80

For the purpose of comparison these same cows are grouped in Table IV as daughters of dams.

After studying these tables it must be concluded that the sire is a very important factor in the building of a herd. The data indicate that the sire Emblagaard Colantha Ladoga, H. B. No. 132103 must be credited with raising the milk production but lowering the butterfat test and the sire Emblagaard Colantha Bonastine, H. B. No. 263137 lowered the production of milk and made no appreciable change in butterfat test. Though Canary Segis Beets, H. B. No. 237625 again lowered the production record of milk he gave a decided increase to the

Table IV.—Records of daughters of Number 9, grouped to show the influence of their dams.

Dam	Cow No.	Milk production pounds	Average test	Calculated butter fat pounds
9	18	10,461	3 00	313 83
	37	14,558	2.81	409.08
	78	10,255	3 16	324.06
18	41	14,733	2 59	355 68
	84	11,778	3 00	353.34
37	50	15,205	2.50	380 13
	64	10,433	2.96	308 82
	82	11,433	3.26	372.72
	153	8,311	3 25	270.01
41	66	12,313	2 68	329.99
	76	9,798	2 88	282 18
	161	6,946	3 20	222 27
84	166	9,364	3.00	280.92
89	167	10,313	3.13	322.80
76	164	7,628	3 00	228.84

butterfat test. Traverse Echo Prince Segis, H. B. No. 465512 followed Canary Segis Beets as head of this herd. On this sire rests much of the future responsibility for the herd. The outcome can be told only when his daughters begin to produce. Fifteen of his daughters by dams of this line will have started production by July 1929. This sire has made a splendid contribution to the herd in type. There is every reason to expect him to make an equally good contribution from the production angle. His sire was Prince Echo Rauwerd, H. B. No. 353211 and his dam was Traverse Segis Nenetta, H. B. No. 305651, who has three seven-day records of 30 pounds of butter and a yearly record of 932.61 pounds of butter and 20,078.7 pounds of milk, an average butterfat test on her yearly record of 3.7 per cent.

Figure 1.—Beauty Pietertje Segis De Kol, H. B. No. 211959, the sixteen year old Foundation Cow of the Upper Peninsula Experiment Station herd.

Figure 2.—Four Great-Granddaughters of Beauty Pietertje Segis De Kol, H. B. No. 211959, sired by Traverse Echo Prince Segis, H. B. No. 465512.

In two instances, sons of Canary Segis Beets were used on their half-sisters because the sire Traverse Echo Prince Segis was not yet ready for service and it was thought better to use a half brother rather than sire on daughter.

The sire used on the daughters of Traverse Echo Prince Segis is Traverse Colantha Sylvia Marathon, H. B. No. 548515. His sire is a son of Wisconsin Fobes 6th, who has a record of 38.58 pounds of butter in seven days and 1,105 pounds in a year. His dam is Traverse Colantha Sylvia Echo, H. B. No. 778124, who has two seven-day records of over 27 pounds of butter and who has a yearly record of 896.337 pounds of butter and 20,845 pounds of milk, an average butterfat test of 3.4 per cent on her yearly record.

The older cows in this line of breeding have been criticised severely because of their low butterfat test. Apparently, the younger cows are

Figure 3.—Four Great-Great-Granddaughters of Beauty Pietertje Segis De Kol, H. B. No. 211959, sired by Traverse Echo Prince Segis, H. B. No. 465512.

Figure 4.—Traverse Echo Prince Segis H. B. No. 465512, whose fifteen daughters, direct descendants of No. 9 will start coming into production in July 1929.

overcoming this criticism but at a loss in total production. If the sires, Traverse Echo Prince Segis and Traverse Colantha Sylvia Marathon, can hold the test of these younger cows in their daughters and can give an increase in production, which is reasonable to expect from the performance record back of them, it would seem reasonable to expect that the next two generations of this foundation cow ought to give a good account of themselves.

There has been 29 male descendants of this line that have already gone into service. Twenty-six of the 29 have headed herds in the Upper Peninsula and were distributed by counties as follows:

Marquette County	8
Delta County	4
Dickinson County	4
Alger County	2
Houghton County	2
Gogebic County	2
Menominee County	2
Chippewa County	1
Iron County	1
Out of the Upper Peninsula	1
Unrecorded	2

ALFALFA PASTURE PROVES VALUABLE FOR PIGS

The Cost of Pork Production is Reduced Materially by Lower Consumption of Protein Feeds

BY. W. E. J. EDWARDS, ANIMAL HUSBANDRY SECTION

Alfalfa is worth $27.87 per acre when used as pasture for pigs if the alfalfa is credited with the value of the feed which it replaces in the pig's ration, and if the portion of the alfalfa which is not pastured off by the pigs is cut for hay and appraised at $7.00 per ton. This value was obtained in pig feeding experiments which have been conducted at the Michigan Experiment Station during the past three years.

These experiments were conducted to compare the rapidity of gains and the cost of gains made by growing and fattening spring pigs which were fed on alfalfa pasture, with those which were made by similar pigs fed the same feeds in a dry lot.

General Plan of the Experiments

During each of the three experiments reported herein, alfalfa pasture was available at all times for the pigs on pasture, and good second cutting alfalfa hay was fed in a rack to the pigs in the dry lot. Each group of pigs was self-fed shelled yellow corn and a supplement which contained equal parts by weight of 60 per cent tankage and old process linseed meal. The pigs also had access to a mineral mixture consisting of 45 pounds feeding bonemeal, 20 pounds pulverized limestone, and 30 pounds common salt. Water was supplied in automatic waterers.

Table I.—Results of the first experiment.

	Lot 1	Lot 4
	Alfalfa pasture	Dry lot
Average daily gains (lbs.)...	1.256	1.299
Feed required for 100 lbs. gain:		
Shelled corn (1), lbs	300 20	291 73
Protein supplements, lbs	37 24	65 56
Minerals, lbs	.69	.69
Alfalfa hay, lbs.	....	5.44
Feed costs for 100 lbs. gain (2)	$5 63	$6 39

(1) Lot 1 was fed 166 lbs. middlings and Lot 4 139 lbs. middlings the first 19 days of the experiment. The middlings are included in the data with the corn.

(2) Feed prices used for the three experiments: Corn $0.84 per bushel, tankage $70.00, linseed meal $50.00, minerals $30.00, and alfalfa hay $12.00 per ton.

Table II.—Results of the second experiment.

	Lot 1 Alfalfa pasture	Lot 4 Dry lot
Average daily gains, lbs	1 440	1 364
Feed required for 100 lbs gain:		
Shelled corn, lbs	309 96	311 08
Protein supplements, lbs	36 80	54 72
Minerals, lbs	1 312	1 348
Alfalfa hay, lbs		8 80
Feed costs for 100 lbs gain	$5 77	$6 38

Fifteen spring pigs were fed until they were finished for market on the same acre of alfalfa during the seasons of 1925, 1926, and 1927. Ten similar pigs were fed to similar weights in the same dry lot during these three seasons.

Each year the alfalfa plot was cut for hay during the feeding period. The average yield was 2,735 pounds.

The alfalfa plot was vacant during the winters but the dry lot was used for other hogs in winter. Before each experiment started, the dry lot was plowed and worked. Care was taken to plow near the fence and in the corners.

A portable cot that had been thoroughly scrubbed and disinfected was placed in each lot for shelter.

The pigs fed on alfalfa pasture (Lot 1) made average gains of 1.256 pounds per day. Those in the dry lot (Lot 4) gained somewhat more rapidly, making average daily gains of 1.299 pounds. The difference between these average gains is so small that it is not significant. This conclusion is borne out by the results from the two later experiments, where the difference is in the same direction one year and in the reverse direction the other year.

Lot 4 consumed somewhat less corn, but required considerably more protein for 100 pounds of gain than did Lot 1. This made the cost of gains $0.76 per 100 pounds higher in Lot 4 than in Lot 1.

Table III.—Results of the third experiment.

	Lot 1 Alfalfa pasture	Lot 4 Dry lot
Average daily gains, lbs	1.234	1.300
Feed required for 100 lbs. gain:		
Shelled corn, lbs	324 60	292.50
Protein supplements, lbs	31 08	76.86
Minerals, lbs	.508	.796
Alfalfa hay, lbs		6.50
Feed costs for 100 pounds gain	$5 81	$6 74

In this experiment the rapidity of daily gains, although not varying widely, are reversed as compared with those of the first experiment. The two lots required practically the same amounts of corn for 100 pounds gain, but, again, the larger quantity of protein supplements consumed by Lot 4 raised the cost of 100 pounds of gain $0.61 higher in this lot than in Lot 1.

The gains made in this experiment compare favorably with those produced in the first experiment. Lot 1 made average daily gains of 1.234 pounds and Lot 4 gained 1.300 pounds daily.

Lot 4 consumed considerably less corn than did Lot 1, but about two and one-half times as much protein supplement. This increased the costs of gains appreciably, making the costs for 100 pounds gain $0.93 higher than those of Lot 1.

The Three Experiments Are Averaged

Table IV.—Alfalfa pasture versus dry lot for growing and fattening pigs. Average of three years.

	Lot 1	Lot 4
	Alfalfa pasture, Sh corn, tankage, linseed meal, minerals	Dry lot – Sh. corn, tankage, linseed meal, minerals, alfalfa hay
Area of plot	1 acre	⅛ acre
No of pigs	45	30
No of days	124	12. 66
Av. initial weight, lbs	42 80	41 93
Av. final weight, lbs	208 91	208 53
Av. daily gain per pig, lbs	1 309	1 321
Av. daily feed consumed·		
Sh corn, lbs	4 071	3 945
Tankage, lbs	231	431
Linseed meal, lbs	231	431
Minerals, lbs	011	013
Alfalfa hay, lbs		091
Total, minus alfalfa hay, lbs	4 544	4 820
Feed required for 100 lbs. gain.		
Sh. corn, lbs	311 02	298 64
Tankage, lbs	17 62	32 64
Linseed meal, lbs.	17 62	32 64
Minerals, lbs	85	95
Alfalfa hay, lbs.	.	6 92
Total, minus alfalfa hay, lbs	347 11	364 87
Cost of feed for 100 lbs. gain:		
Sh. corn	$4 67	$4 48
Tankage	.61	1 14
Linseed meal	.44	82
Minerals	01	01
Alfalfa hay	..	04
Total	5 73	6 49

Discussion of the Three-Year Averages

The pigs fed in the Dry Lot gained .012 pounds per day more than did the pigs fed on alfalfa pasture. This difference is not significant.

It should be emphasized that special precautions were taken to put

the dry lot in a sanitary condition each spring before the pigs were put in. This no doubt accounts, in large measure, for the favorable gains made by these pigs. In many cases where pasture is not provided, the pigs are kept in a filthy insanitary lot. Under these conditions, alfalfa pasture would give much more favorable results both in daily gains and in cost of production than is shown in these experiments.

Alfalfa hay was not consumed in sufficient quantity to supply as much protein to the pigs fed in the dry lot as was obtained by the pigs in the other lot from the alfalfa pasture. This is probably one reason why the pigs fed in the Dry Lot consumed almost twice as much tankage and linseed meal as was eaten by the pigs on alfalfa pasture. Although the Dry lot pigs consumed a smaller amount of corn for 100 pounds of gain, the larger amount of protein supplements which was eaten increased the cost of 100 pounds of gain $0.76 above the cost for the pigs fed while on alfalfa pasture.

For the three years, the average gain in live weight produced on the acre of alfalfa was 2,407.6 pounds. Considering the lower cost of production of $0.76 per 100 pounds gain, and appraising the alfalfa hay which was cut at $7.00 per ton (standing) gave the alfalfa pasture a feeding value of $27.87 per acre.

The high feeding value of alfalfa pasture as shown by these experiments, indicates that this valuable forage crop should be used more extensively in the production of pork.

Where alfalfa pasture is not available Dwarf Essex rape may be used to good advantage. In three experiments conducted at this Station, rape had practically the same value as alfalfa for growing and fattening spring pigs when the same feeds were fed in each case.

TREATING WINTER INJURY OF APPLE TREES

Some Varieties Such As Golden Delicious Are Especially Subject to Damage

BY H. M. WELLS, HORTICULTURAL SECTION

Since the earliest days of fruit growing in Michigan, collar injury to apple trees has occurred sporadically. It has not been confined to the coldest winters, it is inconspicuous, and it does not kill the trees outright. Consequently it may pass unnoticed until its secondary consequences, borers, fire blight, and heart rot, have drawn attention to it; by this time, the real cause may be hard to detect and remedial treatment be difficult or ineffective. The injury may involve only a small area near the surface of the soil and is usually indicated by a vertical crack in the bark, from one to three inches long. Generally, if not invariably, this injury is accompanied by black heart in the wood. In any case, the tree is girdled, wholly or partly, just as truly as though mice had gnawed the bark away. Many of the trees thus affected linger several years before death overtakes them.

Though there is abundant record of these happenings in the past (Spec. Bul. 149) and though orchards show abundant evidence of recent occurrence, there is little or no record of any attempt at treatment of these cases. Therefore this case record should be profitable.

In the spring of 1923, adjoining plantings of 252 Golden Delicious and 125 Delicious trees were made at the Graham Horticultural Experiment Station. For the first two seasons after the orchard was set, the usual clean cultivation-cover crop system of management was followed. In the spring of 1925, the orchard was again plowed and cultivated until July 15th, when it was seeded to alfalfa. The rainfall during the late summer and early fall of that year was moderate to heavy. This kept the trees growing late, and this comparatively late growing period was followed by low temperatures late in October that resulted in considerable winter injury.

Early in the spring of 1926, it was observed that all of the Golden Delicious trees, with the exception of two, had been more or less severely injured at the crown with an occasional tree showing injury in the crotches of the branches. The Delicous trees adjoining were almost entirely uninjured. This occasion was utilized for a trial of several plausible treatments.

For convenient comparison, the block was divided into seven plots of 36 trees each and the following treatments utilized: (1) The first lot were cut off at the top of the ground below the injured area and cleft grafted to Golden Delicious; (2) the second lot were bridge grafted, using Duchess and Northern Spy cions; (3) three one-year-old nursery trees were set around each tree in the third lot and approach grafted into the tree above the crown; (4) all trees of the fourth lot were cut off below the injured part and allowed to produce suckers; (5) the dead bark was removed from the fifth group of trees and plastic-elastigum applied to the exposed wood to prevent its drying out; (6) the sixth lot was treated in the same manner as the fifth, except that white lead paint was used in the place of the other material; (7) the seventh group was left untreated, as a check against the other methods.

Effect of Treatments Examined

At the close of the third subsequent growing season, examination was made to determine the number of trees under each treatment which had been successfully repaired and to find how many were missing or were in such bad condition that they could not be repaired. The percentages of trees successfully repaired, those which are still standing in the orchard but are badly damaged, and those which are missing have been grouped according to treatments in Table I.

Table I.—Percentages of trees successfully repaired, badly damaged, and lost with each treatment, as recorded in the fall 1928.

Lot	Treatment	Percentages		
		Successful	Badly damaged	Missing
1	Cleft grafted at crown	33		67
2	Bridge grafted	39	50	11
3	Approach grafted	14	47	33
4	Cut off and "suckered up"	22		78
5	Dead bark removed; plastic-elastigum used for covering		53	47
6	Dead bark removed, white lead paint used for covering		37	63
7	Untreated or check	*25	42	33

*Note—Trees in group marked with asterisk still show injury but have almost healed over.

Bridge grafting, with 39 per cent of the trees successfully treated, has proved most satisfactory. However, with this method, as is also the case where the approach graft was used, swaying of the trees by wind prevented many cions from uniting satisfactorily at their upper end. With older trees, there would be less trouble of this kind, and, had these trees been staked, the results would have been better. An-

other factor which undoubtedly was responsible for some cions failing to unite was the browning, black heart, of the wood tissues at considerable distances above the injured part of the tree. A typical winter injured Golden Delicious trees that has been saved through the timely

Figure 1.—A cleft grafted tree that has made a satisfactory growth since the cions were set, following winter injury to the crown. The extra cion could well be suppressed more by pruning than is shown here.

use of the bridge graft is shown in Fig. 1. Cleft grafting, though not as successful in tender varieties as the bridge graft treatment, offers possibilities where it may be desirable to change to some hardier variety. Grafting to Golden Delicious leaves the tree subject to the

same injury at some later date. That this actually happens was clearly demonstrated in our own work. Many of the cions set in the spring of 1926 grew nicely only to be winter killed during the winter of 1926-1927. This in part accounts for the fact that only 33 per cent of the trees in this lot were growing in the fall of 1928. Possibly, fall mounding would have reduced this loss. Incidentally, it illustrates the

Figure 2.—Bridge grafting dead areas on young tree trunks is often a satisfactory way of saving trees girdled by rabbits or by winter injury.

Figure 3.—An untreated tree three years after the time it was winter injured at the crown.

desirability of growing tender varieties as double-worked trees. Fig. 2 shows a cleft-grafted Golden Delicious tree with both cions still growing. The smaller one will be cut away leaving the larger to form the tree. Cutting off the tree below the injured area and taking chances that suckers will come up from above the graft union cannot be recommended. Neither is it satisfactory to remove the dead bark and apply

a covering of paint or other material to prevent the drying of the wood. This might be more efficacious in mice-girdled trees, but, in these cases, the wood itself is affected.

Of the trees that were left without treatment, 33 per cent are missing after three years. Another 25 per cent are in fair condition and may live for several years before they finally succumb to the ravages of wood rotting fungi and strong winds. The other 42 per cent are in much the same condition as the tree shown in Fig. 3.

Conclusions

In conclusion, it may be said that the Golden Delicious is a variety that should be classed with those which are extremely subject to winter injury. If it is to be grown at all in sections where injury is likely to occur, it should be double worked. When it is desirable to save trees that have been injured, bridge grafting or cleft grafting should be used, followed by early cessation of tillage and by fall mounding for the first year or two. Because of the black heart that is likely to be associated with this type of injury, recovery is less probable than it is with mice-injured trees, and, in the majority of cases, trees under four or five years of age that have been badly injured should be removed and replaced with sound stock.

DIRECT IODIZING OF MILK IS POSSIBLE

Feeding of Chemicals or Seaweed to Cows Not Needed to Obtain Milk Containing Iodine

BY E. D DEVEREUX, BACTERIOLOGICAL SECTION

In the past few years, an effort has been made to improve the nutritive value of milk. The values of fats, proteins, sugar, mineral salts, and vitamins in milk have been recognized. Some investigators are of the opinion that the dietary value of milk would be increased if it contained iodine or a greater percentage of iodine. Since the quantity of some of the constituents of milk, such as fat, mineral salts, and vitamins, has been altered by feeding experiments in an effort to improve a product of nature, it was to be expected that the iodine content would also receive similar attention.

Feeding of calcium, potassium, and sodium iodides or seaweed has been the method employed in attempting to produce iodized milk. The Health News of the New York State Department of Health (1) briefly makes reference to some experimental work that is being conducted on the dairy farm of Mrs. Medell McCormick, member of Congress. In this work, it is reported that milk containing 350 to 400 parts per million of iodine has been produced by feeding a seaweed and fish mixture. The amount of this mixture fed was not stated. A number of experiments have been conducted at the Ohio Agricultural Experiment Station. In one of these experiments (2), six cows were used; two received no iodine, two received approximately 60 grams of dulce (a seaweed), one received approximately .07 gram of calcium iodide, and the other received approximately .07 gram potassium iodide per day "Samples of milk from these cows failed to show any trace of iodine before the experimental feeding started. After the iodine had been fed for approximately 30 days, samples were again analyzed, and the milk from the check cows showed no iodine while the milk from the four receiving iodine in one form or another showed traces of iodine, estimated from one part in 100 million to one part in 10 million." Only a small part of the iodine fed appeared in the milk, and the amount which did appear was less than in milk in regions where the feeds are rich in iodine.

From the literature cited above, it appears that the control of the quantity of iodine in the milk, which because of its metabolic properties is imperative, would be very difficult.

(1) Health News 6 (1929) No. 3.
(2) Certified Milk 3 (1929) 11-12.

Method For Direct Iodizing

In some experimental work at this station, the iodizing of milk has been tried not by feeding iodine containing substances to cows, but by adding directly to milk molecular iodine in the form of Colloidal Iodine Chandler. The iodine is in suspension in water, which is a desirable factor, and is very active chemically. This form of iodine has been administered in one ounce doses of 2 per cent and 4 per cent concentrations directly into the gizzard of hundreds of thousands of chickens for the successful treatment of worms (3). The chickens suffer no ill effects. According to some experimental work being conducted at the Alabama Polytechnic Institute, Auburn, Alabama, chickens are not thrown off egg production but actually show an increase after being treated. In some unpublished work of Dr. W. L. Chandler of this station, three ounce doses of a 2 per cent Colloidal Iodine (approximately 1.5 grams of iodine) have been administered to sheep in a treatment against parasites, the iodine had no apparent harmful effects on the sheep.

If it is found desirable to use milk as a carrier for iodine, the colloidal form of it can be added directly to the milk in any quantity desired. It is unnecessary to resort to any questionable and tedious means of getting the iodine into the milk and to a chemical analysis to ascertain the quantity present or whether any is present. Iodine in this form combines readily with the milk proteins and unsaturated fatty acids. Within 20 to 30 seconds after adding sufficient iodine to milk to make 100 parts per million, the brown coloration disappears and the milk is again normal in color. The taste of the milk is unaltered up to concentrations as high as 90 to 100 parts per million of iodine, which is a great excess for dietary purposes; and, as the milk ages and sours, no abnormal taste develops. In the light of further knowledge about Colloidal Iodine, probably, therapeutic doses of it can be administered in milk under a physician's guidance. This form of iodine, because of its great germicidal power, offers some interesting problems in the production of a sterile milk for bacteriological and therapeutic purposes.

(3) Poultry Science 6 (1926) 31-35.

TOPPING CORN DOES NOT CONTROL CORN BORER

Experiments Also Show That This Practice Reduces Corn Yield

BY C. B. DIBBLE, ENTOMOLOGICAL SECTION, AND A. R. MARSTON, FARM CROPS SECTION

The fact that many young corn borers establish themselves in the succulent upper parts of infested corn plants early in the season has suggested the possibility that the cutting out and removal of such tops from the corn might materially lessen the number of borers in badly infested fields. This possibility led to an experiment at the Michigan State College Corn Borer Station at Monroe.

The work was done under field conditions typical in that district. In 1927, single row plats were used and topped at three different heights, and every fourth row was left untopped as a check. Two replications of the series were planted. The tops were removed uniformly within each of three different plats. In the first case, they were cut off just above the ear; in the second, midway between the ear and tassel; and, in the third case, only the tassels were removed. This resulted in cutting the stalks approximately four, five, and six feet from the ground.

Topping was done immediately after pollinization of the corn had taken place and the silks had turned brown. In these plats, the infestation was light but a fair number of borers were removed in each case. In 1927, the arrangement of the plats was such that some migration undoubtedly took place between plants of different heights, and, for this reason, the final count did not show results such as were ex-

Topping height	Borers removed with tassel	Borers found at harvest	Yield bus. per acre 14% moisture
Check (untopped)	0	6 3	57 2
Just below tassel (6 ft)	5	7 2	54 2
Midway between ear and tassel (5 ft)	11	7 5	49.0
Just above ear (4 ft.)	11	8 0	33.9

Corn Topping Trial at Michigan State College Corn Borer Station, Monroe.

pected. In the following tabulation, the figures represent the number of borers found in lots of twenty-five plants from each plat in the 1927 trial.

It will be seen that the more severely topped plants actually carried more borers at harvest time than those topped lightly or not at all. This may have been due to migration early in the fall to the drier stalks of the severely topped plants. It is also apparent that the yield was decreased proportionately to the amount of the plant removed by topping, and that this decrease was marked.

In 1928, a different arrangement of plats was adopted for the purpose of avoiding the migration of larvae. These plats consisted of twelve rows topped at each of the three heights, with checks of a similar size, not topped. The plats were duplicated. The borer popula-

Topping height	Borers removed with tassel	Borers found at harvest	Yield bus. per acre 14 % moisture
Check (untopped)	0	68	66.5
Just below tassel (70 in.)	16	53	63.8
Midway between ear and tassel (60 in.)	19	26	59.2
Just above ear (50 in.)	33	20	41.4

tion in the 1928 test plats was counted on approximately fifty-seven plants taken from the center row of each plat. The preceding table gives the average results of counts of the borer numbers and the crop yield for the two sets of plats.

In conclusion, it would appear that many borers were removed with the tassels and that the resulting population was decreased proportionately with the amount of the plant removed. However, where the most severe topping was practiced, there was a reduction of 25.1 bushels of corn per acre as compared with the untopped check in 1928 and a reduction of 23.3 bushels per acre in 1927.

Summary

Topping decreased the yield of corn.

The number of borers may be reduced by topping.

The decrease in the borer population and the damage averted do not, at present, compensate for the loss due to the cost of topping and the resulting decrease in yield.

SELECTED RASPBERRY PLANTS CUT DISEASE LOSSES

Inspection of Nursery Stock Permits Selection of Healthy Stock For Planting

BY STANLEY JOHNSTON, SOUTH HAVEN EXPE IMENT STATION

In the spring of 1925, a Cumberland black raspberry plantation was started at the South Haven Experiment Station. One-half of the plantation, 572 plants, was set with tips which were laid down the previous August from plants that were examined carefully and which were vigorous and apparently free from disease. The other half of the plantation was set with tips purchased from the trade. They had been laid down in the usual way in an average plantation. They appeared as vigorous as the other lot, though no special attention had been taken in the selection of individual plants. One-half of this new plantation will be designated as Section A, while the other half will be designated as Section B.

During the first summer, nearly 100 plants, or one-fifth of those in Section B, showed symptoms of mosaic or wilt and therefore were dug out and destroyed. Only one mosaic infected plant appeared in Section A. The following year 75 diseased plants had to be rogued out of Section B, while only six plants were taken out of Section A. This same year was the first fruiting season and Section A yielded 26 cases while B yielded 5 cases. In June, 1927, such a large proportion of the plants in Section B were showing mosaic and wilt symptoms that it was considered necessary to destroy this entire half of the plantation because few healthy plants remained and there was danger of infecting all of the other raspberry plantings on the Experiment Station grounds. Section A continued to produce satisfactorily, yielding 36 cases in 1927 and 50.5 cases in 1928. Furthermore, this part of the plantation would have done somewhat better if it had not become infected repeatedly with wilt from the other section.

This experiment shows the great importance of starting the raspberry plantation with clean nursery stock. A good location, a fertile soil and the best of cultural operations cannot guarantee success, if the nursery stock is diseased.

RED CEDAR TREES MENACE STATE ORCHARDS

Are Hosts For Apple Rust Which Is Becoming Prevalent in Michigan.

BY RAY NELSON, BOTANICAL SECTION

The common rust of apples, also known as cedar rust or cedar-rust disease of apples, is a widespread and serious fungous disease of apples in the eastern portion of the United States. In the regions particularly favorable to its development it causes damage to the apple comparable to scab in Michigan. The geographic distribution of the disease embraces the eastern and central portions of the United States from Maine to Florida, extending westward to Nebraska, but rust attains its greatest destructiveness in the prairie states of the central Mississippi valley and the commercial apple districts of Virginia and West Virginia. To the South and West of Michigan the states of Ohio, Indiana and Wisconsin are included in those districts where rust causes important commercial damage to the apple.

Although the rust fungus has been sparingly present in Michigan for many years, it has not caused any serious damage to the apple. The first recorded collections of the disease were from St. Joseph and Washtenaw counties in 1874 and Calhoun county in 1888. Scattered collections of the disease on the red cedar have been made at infrequent intervals since that time, mostly in southern counties and specimens from Gratiot county in 1912 represent the northermost recorded limit of the disease in Michigan. For years it has been predicted that apple rust would probably become a factor that would have to be considered in the apple disease control problem of Michigan fruit growers and at this time, following observations in certain sections of southern Michigan, it seems desirable to call attention of fruit growers to the present status of the disease and the future outlook.

Apple rust is caused by the fungus *Gymnosporagium juniperi-virginiana* and the red cedar tree *Juniperus virginiana* is the secondary host that is necessary for the perpetuation of the fungus on the apple. The apple

rust fungus passes a part of its life cycle on the red cedar and part on the apple, both wild and cultivated. The disease may be found on the red cedar at this time of the year as chocolate-brown corky galls (Fig. 1) varying in size from those only a fraction of an inch in diameter to others two inches or more across, and usually more or less kidney-shaped. These galls may be found scattered over the tree and during rainy periods elongated, gelatinous, orange-colored horns or projections are pushed out from the surface depressions on the galls.

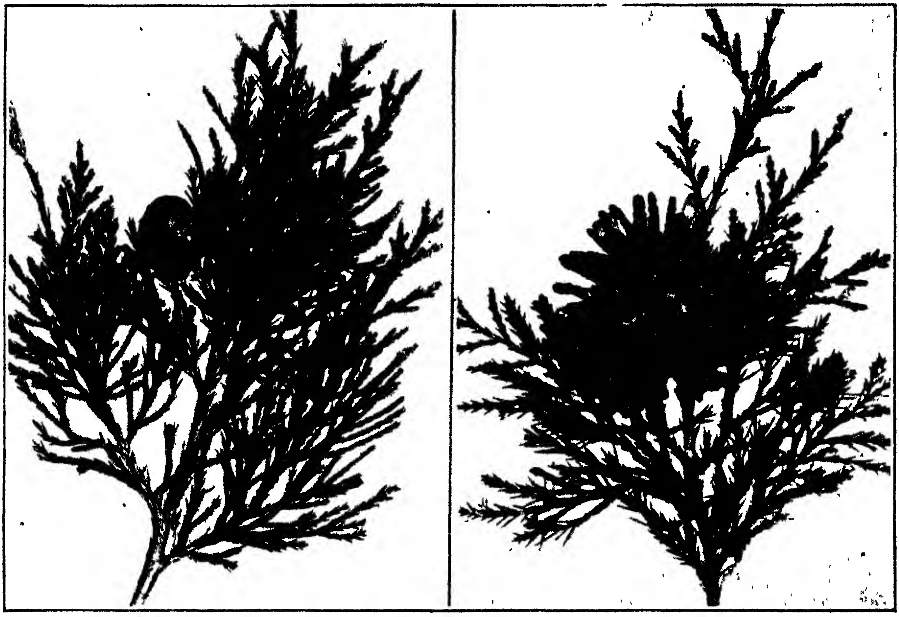

Fig. 1—(A) Gall of the apple rust fungus on the red cedar. Dry condition. (B) Gall on red cedar with completely expanded gelatinous horns. The horns are pushed out during rains and the spores discharged.

These horns, which superficially resemble flowers, have been given the popular name of cedar flowers and are best observed following several hours of rain which causes the swelling and distension of the orange-colored horns. The small galls may produce only one or two horns while very many may be pushed out from the larger galls. The gelatinous horns finally dry up and the galls are left as dark brown to almost black swellings which may remain on the tree for a long time.

The orange-colored horns pushed out from the cedar galls, or cedar-

apples, contain the teliospores of the fungus and these spores germinate while they are still imbedded in the gelatinous material to produce much smaller and lighter spores. When the horns dry slightly, these spores are forcibly ejected into the air, and carried by winds to young apple leaves or fruits. Millions of these tiny spores are produced from each gall during a rain and they must then reach a young apple leaf or fruit in order to continue their development.

Following infection on the apple, the first evidence of rust is the appearance on the upper surface of the young leaves of pale-yellow spots about the size of a pinhead. These spots may appear on the apple at any time within 10 days after the galls on the cedar have been swollen by several hours of rain. Cushion-like swellings then appear on the under surface of the infected leaves and on the surface of these swellings tubular projections, the cluster cups, appear in June and July. In the bottom of these cups masses of powdery brown spores are produced. These spores (aeciospores) sift out of the cups and are carried by wind to the cedar trees where they germinate and infect the new growth and give rise the following year to typical cedar apples or galls, which again produce the gelatinous horns bearing teliospores, thus completing the life cycle of the fungus.

Severe rust infection on the apple causes the infected leaves to turn yellow and fall from the tree. Serious defoliation was noted in one orchard in southwestern Michigan in 1927. Heavily infected leaves may also be curled or variously malformed. Mature leaves are immune.

The spotting of the apple foliage and defoliation results in a weakened tree and a corresponding effect upon the production of fruit. Certain susceptible varieties like Wealthy may show severe fruit infection, mostly at the calyx end and the cluster cups are produced on these fruit lesions. The most important injury to the apple is due to leaf infection and the resultant defoliation and the dwarfing and reduction of the quality of the fruit.

Apple rust has within the past few years become firmly intrenched in certain favorable areas in southern Michigan. The disease is moving northward into Michigan from Ohio and Indiana and the red cedars are conspicuously infected with the rust in dangerous proximity to some of the most important commercial apple districts of the state. Ten years ago galls on the red cedar were few and far between. To-

day the cedar apples may be collected in great quantities in regions where the red cedars are apparently increasing rapidly. The red cedar is found sparingly over the entire state, but in some of the southern counties it is spreading more rapidly than elsewhere.

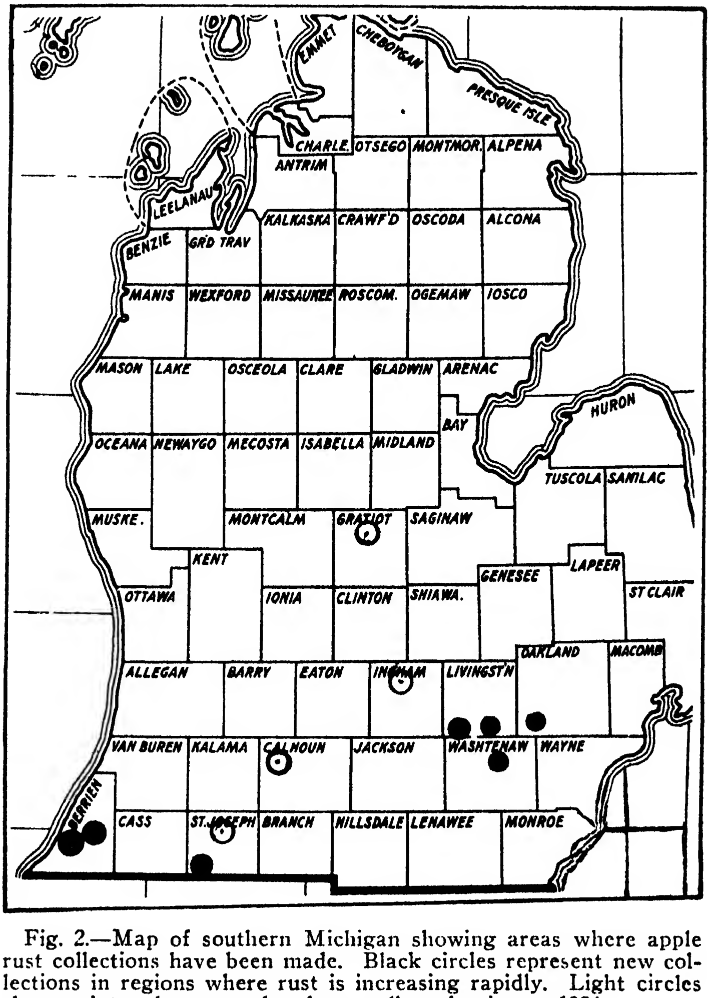

Fig. 2.—Map of southern Michigan showing areas where apple rust collections have been made. Black circles represent new collections in regions where rust is increasing rapidly. Light circles show points where rust has been collected prior to 1924.

The role of birds in the dissemination of seeds of the red cedar is plainly evident in the concentration of trees along fencerows and in the valleys, where congenial conditions are provided for a rapid spread. The red cedar is plainly on the move and the rust is not far behind.

Thousands of trees of all sizes may be found on dry hillsides in Livingston, Washtenaw and Oakland counties and they are also abundant in Berrien and St. Joseph counties. In these five counties rust is commonly found on the cedar trees and in St. Joseph county it has been found causing defoliation of apple trees in commercial orchards. It seems probable that rust will soon be found generally in southern Michigan where the red cedar is present in appreciable numbers within close proximity of apple trees.

The Michigan laws relating to orchard and nursery inspection require that all cedar trees be inspected and found free from dangerous plant diseases and insects before they can be offered for sale. The red cedar is in great demand by landscape gardeners for ornamental plantings and thousands of these trees are being moved from their native habitat along dry hillsides into the cities and to country estates. This tree is also used extensively for windbreaks and old plantings are frequently found along roadsides in southern Michigan. Many of these trees are affected with rust. The efficient inspection service of the State Department of Agriculture detects many cases of rust in the cedars that are being used for ornamental plantings and no tree affected with the rust can be moved. Through the cooperation of the orchard and nursery inspection division of the State Department of Agriculture much valuable information as to the location of infected cedars has been obtained and the preliminary survey reported here is based largely on locations originally found by the state inspectors.

The information that we now have shows us that rust is increasing rapidly in southern Michigan and that it is now dangerously intrenched in some of the most important apple sections. This warning of this potential menace to the apple crop is sounded so that fruit growers may be alert and on the lookout for this disease. Cedars within a mile of commercial orchards should be inspected frequently for the presence of the galls and plantings of red cedar within proximity of apple orchards of susceptible varieties are a potential menace. Cedar hedges for wind breaks around orchards are found in many sections and constitute a serious threat to future apple crops.

The rust situation is not yet serious enough so that the compulsory destruction of the red cedar in the commercial apple sections is warranted, but should rust continue to increase at the present rate it may be necessary to adopt control measures that have proved successful in

other states. These measures include complete eradication of the red cedar around apple orchards. Spraying has not controlled the disease and the removal of red cedar trees surrounding orchards has been the only satisfactory method of control. The development and spread of the rust in Michigan will need to be followed closely so that if it becomes necessary we may be prepared to adopt control measures to protect commercial orchards. Frequent inspection of red cedar trees is needed to provide information as to the increasing spread of the disease. Landscape gardeners and others interested in cedar trees for ornamental plantings should give attention to horticultural varieties of red cedar which can be substituted without danger for the native trees.

Another rust is also found on the red cedar and the galls are similar to those produced by the apple rust fungus. This second rust has for the pomaceous hosts the hawthorn, pear, apple and mountain ash. It is not destructive to apple. The galls on the cedar are smaller, more globular and darker in color than those of the apple rust. In order to be positive as to the type of rust, galls found on red cedar trees should be sent to the Botany Experiment Station, East Lansing, for identification.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
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Circular Bulletins—

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47 Poisoning from Bacillus Botullinus.
48 Spraying for Hopperburn.
49 The Hessian Fly.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

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56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
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*Bulletins listed in bold faced type are recent publications of this Station.

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*Bulletins listed in bold faced type are recent publications of this Station.

Nature of Publications—

Four series of publications are issued by the Experiment Station—Special, Circular, Technical, and Quarterly.

Special bulletins are bulletins of a popular nature, and deal with special lines of work.

Circulars are briefly and concisely written discussions of a popular nature.

Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

Mailing Restrictions—

Single Copies of bulletins are for free distribution as long as the supply lasts. Quantities of bulletins may be secured at cost.

Requests for bulletins should be limited to those actually needed.

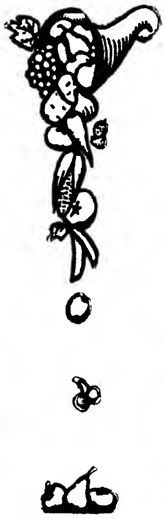
Bulletins are not intended to be used as text books in classes, but, upon application, libraries of colleges and public schools of Michigan will be supplied with a few copies for class reference.

Order by classification and number.

All applications for bulletins should be addressed to V. R. GARDNER, DIRECTOR, East Lansing, Mich.

THE QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science



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V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XII, No. 1, August, 1929

LOW CUTTING REDUCES CORN BORER MENACE

C. B. DIBBLE, ENTOMOLOGICAL SECTION, AND
A. R. MARSTON, FARM CROPS SECTION.

The claim that the number of European corn borers remaining in the field is greatly reduced when corn is cut low at harvest time is substantiated by the results of three years of experimental work at the Michigan State College Corn Borer Station at Monroe.

Many corn fields are annually left with as much as a 15 inch stubble. Ordinary corn binders can be set to cut much lower than this, while binders are made which will cut almost to the surface of the ground, under ideal conditions. Hand corn knives which will leave practically no stubble are also available.

That the use of such equipment reduces the borer population insofar as the equipment is effective in cutting low is borne out by the Monroe trials on corn harvested at the surface of the ground and at heights of 4 inches, 10 inches, and 15 inches.

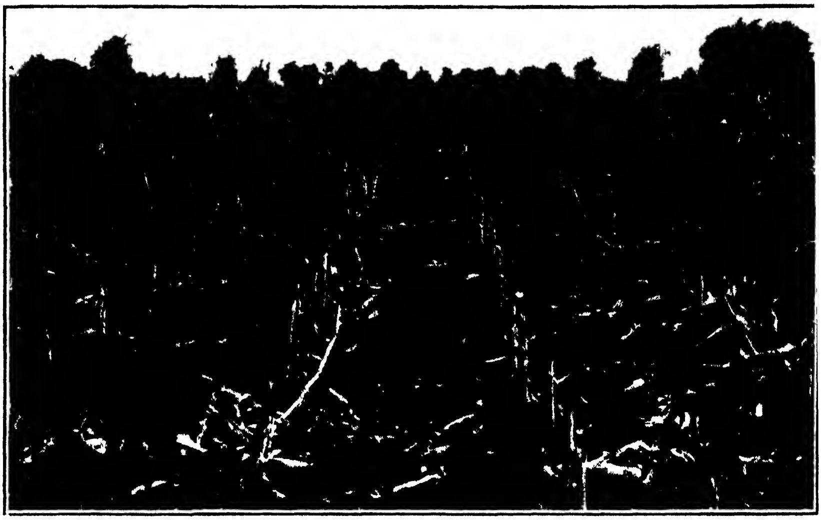
A portion of the corn grown in a "Time of Planting" experiment was used for these cutting trials. These plantings included some 20 varieties of corn with a standard variety as check every fourth plot, all planted at four different dates, April 28th, May 12th, May 25th, and June 9th. After cutting the corn, counts were made by dissecting representative areas of stubble to the tips of the tap roots and the presence or absence and number of borers was recorded.

Table showing number of borers per acre remaining in stubble of various heights. Average for 1926*-1927-1928

Height at which machine was set to cut	Actual average height of stubble left	Number of borers per acre left for each planting date				Average for different stubble heights
		April 28	May 12	May 26	June 9	
Ground surface	2 9 inches	734 0	552 9	130 4	37 6	371 2
4 inches	4 8 inches	1411 1	659 5	437 3	83.7	647 9
10 inches	10 4 inches	2783 2	1816 8	913.2	281.9	1448 8
15 inches	13 7 inches	2890 8	1950 1	1372 9	267.9	1620.4

Notation: The actual average height of stubble remaining in the field differed slightly from the height at which the corn harvester was set. The actual height was determined by measurements made on several hundred stubble representing each of the four cutting heights.

*Entomological data in 1926 were taken by Dr. Philip Lugenbill of the Bureau of Entomology, United States Department of Agriculture.



Fields of high stubble harbor many borers.

Dissecting stubble in the field.

The results of the work at Monroe are shown in the accompanying table. Regardless of the time of planting, the number of borers left in the field was materially reduced by low cutting, the shorter the stubble the fewer borers remaining. The earlier planted corn had many more borers to begin with, but low cutting caused the same propor-

tionate reduction of borer population in the corn from each planting date.

The average number of borers per acre in the field before the corn was cut was 6,696 in 1927 and 1,517 in 1928. The damage was, of course, less severe in the latter case. In 1928, counts were made late in the fall of the number of borers below the surface of the ground. Approximately 20.6 per cent of all borers found in the stubble at this time were below ground. Work at this and other stations indicate that borers which remain in low cut stubble and below the ground surface can be effectively destroyed by clean plowing.

Summary

1. Many corn borers are found in corn stubble.
2. Low-cut stubble harbors fewer borers than high stubble.
3. Borers are found below the surface of the ground and along with those in short stubble may be disposed of by clean plowing.

WHEAT RESPONDS TO PROPER FERTILIZERS

Soil Types and Methods of Working Soil Influence Analyses To Be Used

G. M. GRANTHAM, SOIL SECTION

The proper fertilization of soils for wheat depends upon the texture of the soil, the system of farming which has been used, and whether or not a seeding is to be made in the wheat in the spring.

Soil Type Is Important

The heavy sandy loams, silt loams, and clay loams are really the wheat soils of the state, however, the lighter classes of soil are used to a certain extent for wheat production. The heavy soil types respond especially well to phosphate with small ratios of nitrogen and potash. The lighter soils are usually somewhat depleted in fertility and are responsive to complete fertilizers carrying a low to medium ratio of nitrogen, high ratio of phosphate, and medium to high ratio of potash.

Systems of Farming

The system of farming to which a soil has been subjected is a factor to be considered in fertilizing for wheat. If barnyard manure has been used frequently or if legumes have been grown and turned under in the rotation, then the ratio of nitrogen and potash should be small and the phosphate ratio large. On land which has received no manure or green manures, a well balanced complete fertilizer should be used. If

barnyard manure is turned under just previous to seeding of the wheat on heavy lands, phosphate is the only ingredient needed as a fall application. Where manure is plowed down just before seeding on light soils, it is advisable to use a large ratio of phosphate and small to medium amounts of nitrogen and potash.

If spring seedings of clover, sweet clover, or alfalfa are to be made

Table I.—Fertilizer recommendations for wheat.

SANDS AND LIGHT SANDY LOAMS

Wheat	No manure or leguminous green manure used within the las two years	Clover or alfalfa grown within the last two years	Manured within the last two years
With no seeding of clover or alfalfa	2-12-6 or 4-16-8	2-16-2 or 2-12-6	2-16-2
With seeding of clover or alfalfa	Legume seedings usually not recommended in this group	2-12-6 or 2-10-8	2-12-6

HEAVY SANDY LOAMS, SILT LOAMS AND CLAY LOAMS

Wheat	No manure or leguminous green manure used within the last two years	Clover or alfalfa grown within the last two years	Manured within the last two years
With no seeding of clover or alfalfa	2-16-2 or 4-16-4	2-16-2	0-20-0
With seeding of clover or alfalfa	2-12-6 or 4-16-8	2-12-6 or 2-16-2	0-20-0

in the wheat, the fertilizers for the legume seeding should be applied at the time of seeding the wheat. On the lighter soils, unless the land is fairly productive, it is advisable not to make spring seedings in the wheat. If the land is productive so seedings can be made, it is advisable to increase the ratio of potash in the fertilizer used for the wheat and legume seeding. On the heavy types of soil, the less productive ones should contain in addition to the fertilizer for wheat a slightly larger per cent of potash. On the productive classes of heavy soils, a large ratio of phosphate should be used for both wheat and legume seeding.

Methods of Applying

There is no better method of applying fertilizer for wheat than by means of the grain drill with a fertilizer attachment. When fertilizer attachment is not obtainable, the fertilizer can be broadcast by hand or by means of a lime spreader, and it should then be worked deeply into the soil before the wheat is seeded.

Amounts of Fertilizer to Apply

The amounts of fertilizer to apply should be 200 pounds or more per acre for wheat, and, where a seeding is to be made in the wheat, then 300 pounds or more per acre should be used. If low anal-

ysis fertilizers are used, proportionally larger amounts should be applied. If extremely high analysis fertilizers are to be used, the amounts per acre should be reduced.

SEEDLINGS AND SPROUTS HAVE DIFFERENT VALUE

Methods of Forest Reproduction Affect Worth of Products From Woodlot

R. H. WESTVELD, FORESTRY SECTION

Woodlot owners who are managing their woodlots with the object of making them as profitable as possible recognize the importance of harvesting the mature timber in such a way that the more valuable species will be favored in the second crop. They are not always aware, however, of the significance of the origin of the individual trees. All natural growth in a woodlot may be classified into four groups, which are seedlings, sprouts, seedling-sprouts, and suckers. Each of these forms of growth have individual characteristics and qualities which make their relative value as components of a woodlot of practical significance. The superiority of one over another, however, depends on the purpose for which the woodlot is being managed, particularly with reference to the type of product that is being grown and the length of time required to produce the final product.

Classes of Growth

In order to differentiate the four growth forms mentioned above, the following definitions are given:

A seedling is a tree grown from a seed. In the case of a natural woodlot, the seedlings originate from seed which falls from standing trees.

A sprout is a tree which has grown from a stump over two inches in diameter.

A seedling-sprout is a tree which has grown from a stump two inches or less in diameter. It usually originates from a seedling which is cut or accidentally broken off.

A sucker is a shoot from a root.

The first two classes are the most common forms of growth found in most woodlots. In some cases, seedling-sprouts may constitute a large percentage of the trees but they so nearly resemble seedlings in late life that it is very difficult to distinguish them in old stands of timber. The qualities of the seedling-sprout are so similar to those of the seedling that for practical purposes, a distinction is not essential. Suckers are characteristic of only a few species, chiefly beech and poplar, so they are confined to woodlots in which these species occur.

An examination of 200 stumps on a representative area in one of the College woodlots showed that these two species were the only ones which did not reproduce by sprouts from the stump. The species examined included red oak, white oak, hard maple, elm, black ash, black cherry, soft maple, basswood, tulip, poplar, hickory, and sassafras.

Qualities of Sprouts and Seedlings

The sprout has two qualities which have led some woodlot owners to prefer this class of growth to the seedling. First, reproduction is relatively simple, rapid, and inexpensive; second, the rate of growth in youth is more rapid than that of a seedling. Although the first point is unquestionably sound, the second is of very 'ittle practical significance. Leffleman* has shown that this advantage is only temporary and that by the fortieth year there is no essential difference in the total height or rate of growth of these two growth forms.

The chief objection to a tree of sprout origin is its susceptibility to rot. The cut surface of the stump offers an excellent opportunity for the entrance of wood-destroying fungi and sooner or later a large percentage of the sprout growth is affected by butt rot. Of 155 trees of sprout origin examined in one of the College woodlots, 50 were partially rotten at the base. The decay becomes more prominent as the trees become older. An analysis of the 155 trees showed that 28 per cent of the trees under 10 inches in diameter were affected by rot whereas 70 per cent of the trees over 10 inches were affected. Less than 5 per cent of seedlings examined showed any sign of decay. Decay of any kind, but particularly at the base of a tree, greatly reduces the ability of the tree to resist winds so there is always a greater danger of windfall among the older sprouts than among the seedlings.

Several sprouts usually originate from each stump but the weaker ones are gradually crowded out by the stronger, more rapid growing individuals. By the time the trees are 15 or 20 years old, only two to four stems remain in a clump. Since the bases of the sprouts from any one stump are very close together, the boles of the trees, in order to allow the crowns to develop properly, will grow at an angle and unless all but one of the stems is removed at an early age, all of the trees will be leaning or crooked. Such defect reduces the quantity of lumber which can be sawed from a tree. Trees of seedling origin occur singly, and unless they are growing too much in the open they will develop a straight bole. Where lumber is the final product, the seedling is superior to the sprout.

Ways to Encourage Seedlings

Although the seedling is unquestionably superior to the sprout in all qualities except one, ease of regeneration, the latter can still have a place in the forest. Particularly where the woodlot is being managed for cordwood, sprouts can form a large percentage of the stand, since quality of the product is of little importance. Furthermore, the trees are usually cut before they reach a diameter of 12 inches when rot

*Leffleman, Louis J. and Hawley, Ralph C. Studies of Connecticut Hardwoods, the Treatment of Advance Growth Arising as a Result of Thinnings and Shelterwood Cuttings. Yale University, School of Forestry, Bulletin No. 15.

becomes a serious matter. Even in cordwood production, however, seedling reproduction should continually be encouraged because gradually the old stumps lose their vigor, sprout weakly, and eventually are destroyed by rot.

In saw timber production, seedlings should be favored over sprouts. In making thinnings or improvement cuttings in the woodlot, sprouts should be cut first. In this way, the bulk of the final stand will be composed of seedlings. Regeneration of the woodlot by seedlings is nature's way of establishing a forest cover and this can be encouraged by eliminating grazing in the woodlot, through proper cutting and by fire protection. This is not as simple as regeneration by sprouts but in the long run it is more profitable.

AVIRULENT VACCINE DECREASES CATTLE ABORTION

Further Study Will Be Made of This Method in Cooperation With Michigan Dairymen

WARD GILTNER, BACTERIOLOGICAL SECTION

In March 1922, Dr. I. Forest Huddleson published, in Technical Bulletin 55, reports on the study of many strains of the abortion bacillus (Bang's bacillus), the cause of infectious abortion of cattle or Bang's disease. One of the strains, isolated from a case of abortion, proved to be avirulent, that is, it would not infect guinea pigs, experimental animals which are very susceptible to this infection. Later, it was proved that this particular strain of the abortion germ would not infect cattle. It would neither cause pregnant cattle to abort nor would it establish itself in the udder or elsewhere in the tissues or organs of the cow. It was then logically, attempted to demonstrate that cultures of this organism could be used safely and successfully as a vaccine against infectious abortion.

In March 1924, Doctor Huddleson published, in Technical Bulletin 65, the results of the use of this vaccine on 118 animals in five herds and 23 animals in the Station abortion experimental herds to the effect that a non-virulent living culture of *Brucella abortus* could be injected subcutaneously into both pregnant and non-pregnant cattle without harmful effects. It was shown also that cattle which had been treated possessed immunity against *Br. abortus* infection.

In March 1929, Doctor Huddleson published, in Technical Bulletin 98, still further data on the use of this avirulent culture vaccine. The summary of that work follows:

"The results and effects of injecting a non-virulent living *Br. abortus* vaccine into 175 non-reacting breeding cattle in 10 different herds have been presented in the foregoing data [in Technical Bulletin No. 98]. In the 10 herds were also 152 untreated animals reacting to the agglutination test.

"During the first year following the vaccine treatment, seven animals, or 4 per cent, of the non-reacting treated animals aborted. Of those observed during a second period, 108 in number, only one, or 0.9 per cent, aborted.

"In the 152 reacting animals, 27, or 24 per cent, aborted during the first year of observation and six, or 9.8 per cent, out of 61 during the second year.

"Only five of the treated animals were sold because of breeding trouble, while 38 of the reacting ones were sold for this reason.

"There is no indication that the vaccine caused any harmful effects or reduced the breeding efficiency of the treated animals.

"The breeding data and a few bacteriological data indicate that a high percentage of the animals were protected against *Br. abortus* infection."

In the meantime, Doctor Schlingman of Parke, Davis, and Company, Detroit, and Doctor Huddleson have accumulated data on many more cattle in other herds. Their records are not yet in published form but they bear out the conclusions made on the basis of the work reported in Technical Bulletins 65 and 98.

After seven years of study of this avirulent culture, bacteriologists at Michigan State College are convinced that safe and effective vaccination against Bang's disease is a hopeful possibility that may yet be made practicable. The bacteriology department has been fortunate enough to gain the cooperation of the Bureau of Animal Industry of the U. S. Department of Agriculture. Dr. D. B. Meyer* is now agent of the Bureau of Animal Industry and will work, it is hoped for several years, on this project in Michigan, making the Section of Bacteriology and Animal Pathology his headquarters. It is his plan, through cooperation with practicing veterinarians throughout the State to get in touch with a large number of herds in which Bang's abortion disease is known to exist and in which the breeding records are accurately kept and where adequate controls can be maintained in experimental work.

If, after careful consideration of all the factors concerned, a herd appears favorable for the purposes of a demonstration of the value of the avirulent vaccine it will be taken on as an experimental herd. On the basis of the agglutination test, the non-infected animals will be determined and these will be divided into two groups, one of which will be vaccinated with the avirulent culture while the other group will be left untreated as controls. It is planned that these herds will be kept under observation for a number of years and constant bacteriological and serological checks will be made on all the animals accurately to determine their condition with respect to infection and immunity. The work on the herds will entail no expense or great inconvenience to the owner or danger to the treated cattle.

*Technician in the Section of Animal Pathology, 1928-29.

RATIONS SHOW PROFIT IN FATTENING BABY BEEF

Food Values of Corn, Barley, and Protein Supplements Are Tested

G. A. BRANAMAN AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

The increasing popularity of light cattle on the market has raised the question as to what really is baby beef. The Secretary of Agriculture in 1926 defined, under the Meat Inspection Act of 1906, baby beef to mean the carcass from steers or heifers of the beef breeds, weighing between 600 and 1200 pounds on the hoof and the age between six and eighteen months. A little more definite practice on the beef markets restricts baby beef to mean the carcasses from prime and choice fat cattle from 10 to 18 months of age and weighing under 1,000 pounds. The consumers' demand for small cuts of choice beef has kept the price of these cattle near the top of the beef market constantly for several years. From the farmer's standpoint, this is a fortunate circumstance, since less feed is required to produce a pound of gain on the younger cattle.

Michigan Grown Calves Are Fed

Six experiments in fattening baby beef calves for market have been completed at the Michigan Experiment Station. The Station Quarterly Bulletin for August of each year gives the report of the previous winter feeding trials.

The calves fed during the winter of 1928-29 were produced in Sanilac County, Michigan, from grade Hereford cows and purebred bulls. Fifteen steers and 15 heifers were selected from a calf crop of 92 head, the main object being to obtain a uniform lot of calves. They were given the tuberculin test and dehorned before starting on feed.

The calves were divided into three lots, five steers and five heifers in each lot; and were as nearly equal as possible from the standpoint of type, quality, condition, age, and weight. Individual weights were taken for three successive days at the beginning and at the close of the trial, and every 10 days during the rest of the feeding period.

Cost of Calves

The cost in the feed lots on November 21, including freight, feed, and all expenses until started on feed was $13.70 per cwt.

Objects of Experiment

The experimental work was conducted to compare:

1. Ground barley versus shelled corn when fed with corn silage and alfalfa hay.
2. Linseed meal versus alfalfa hay alone as the source of protein when fed with shelled corn and corn silage.

Rations Fed

Lot 1. Ground barley—corn silage—alfalfa hay.
Lot 2. Shelled corn—linseed meal—corn silage—alfalfa hay.
Lot 3. Shelled corn—corn silage—alfalfa hay.

The feeding period began November 21, 1928, and continued 195 days, until June 4, 1929. The calves in each lot received all the silage they would clean up readily twice daily, and alfalfa hay was kept before them in racks. A mixture of equal parts bone-meal and salt was kept before them in boxes.

A mixture of equal parts by weight of whole oats and ground barley (or shelled corn) was fed the first 60 days, three parts barley (or corn), and one part oats the next 30 days, and barley (or corn) alone the last 105 days. About six pounds of grain per calf per day was fed during the first 80 days, eight pounds the next 30 days, nine pounds the next 30 days, 11 pounds the next 20 days, and 12.5 pounds the last 35 days.

As compared with lot 3, one pound of grain in lot 2 was replaced by a pound of linseed meal during the first 90 days 1.25 pounds the next 70 days, and two pounds the last 35 days.

Lot 1 would not take a larger amount of grain later in the period. Lot 3 cleaned up the corn more readily than lot 1 did the barley, but the amounts were kept approximately the same. However, lot 2 seemed eager for more and they were increased up to 12 pounds of corn in addition to the two pounds of linseed meal during the last month.

Calves Waste But Little Feed

There was not enough grain in the droppings to warrant putting pigs behind the calves until December 29. At that time, two 45-pound pigs were placed in each lot and fed some extra shelled corn and tankage. The pigs in the barley lot were apparently getting very little of the ground barley. There was hardly enough feed in either of the other lots to full-feed one pig.

Linseed Meal Increased the Profits

The linseed meal fed to lot 2, in addition to the ration of shelled corn, corn silage, and alfalfa hay received by lot 3, increased the average daily gain 0.15 pounds and increased the selling value 20 cents per hundredweight. The returns per calf above feed cost, crediting pork produced from the droppings, were thus increased $2.83 and the returns per bushel of shelled corn were increased 22 cents. The return per bushel of shelled corn fed was obtained by charging the other feeds at the prices named in the table and crediting all other returns to the shelled corn fed.

Two of the most important things in determining the profits in cattle feeding are the feed cost per hundred pounds of gain on the cattle and the selling value or margin between cost price and selling price. The calves fed linseed meal, lot 2, gained faster than those in lot 3, the feed cost was practically the same, more pork was produced from the undigested corn, and they carried enough more finish to sell 20 cents per hundredweight higher.

Barley versus Corn

The calves in lot 1, which were fed the ground barley, made practically the same gain as those fed the shelled corn in lot 3. There was very little difference in the finish, the corn-fed calves being valued five cents per hundred pounds higher than the barley-fed calves. The

barley-fed calves required slightly less feed for 100 pounds gain, while the pigs made more gain in the corn-fed lot, so that the total return above feed cost was practically the same in each lot.

It should also be noticed that the prices charged for ground barley and shelled corn have been the same per pound; no charge has been made for grinding the barley.

Summary of Results

	Nov. 21, 1928 June 4, 1929—195 days		
	Lot 1 Gr barley	Lot 2 Sh. corn, linseed meal	Lot 3 Sh. corn
No calves per lot	9	10	10
	Lbs.	Lbs.	Lbs.
Initial weight per calf	392 9	396 4	396 3
Final weight per calf	751 3	783 8	753 9
Total gain per calf	358 4	387 4	357 6
Average daily gain	1 838	1 987	1 833
Average daily ration:			
Ground barley	6 65		
Shelled corn		6 07	7 04
Whole oats	1 24	1 05	1 24
Linseed meal		1 24	
Corn silage	9 60	11 76	9 50
Alfalfa hay	5 41	5 25	5 58
Feed per cwt. gain:			
Ground barley	362 1		
Shelled corn		305 5	383 9
Whole oats	67 5	52 8	67 7
Linseed meal		62 5	
Corn silage	522 0	592 0	518 0
Alfalfa hay	294 2	264 1	304 3
Feed cost per cwt. gain	$10 59	$11 05	$11 02
Pork credit per calf at $10 50 per cwt	1 35	3 17	2 65
Feed cost per cwt gain (crediting pork)	10 21	10 24	10 28
Initial cost in lots per cwt	$13 70	$13 70	$13 70
Initial cost in lots per calf	53 83	54 31	54 29
Feed cost per calf	37 95	42 82	39 42
Cost of calf plus feed cost	91 78	97 13	93 71
Necessary selling price in lots to break even (crediting pork).	12 03	11 99	12 08
Selling price in lots (market price less $1.00)	13 85	14 10	13 90
Selling price per head in lots	104 05	110 52	104 79
Returns per head above feed costs:			
Omitting pork	12 27	13 39	11 08
Crediting pork	13 62	16 56	13 73
Return per bu. gr. barley or sh corn	1 34	1 76	1 54
Return per cwt. gr. barley or sh. corn	2 80	3 15	2 75

Prices of feeds:

Ground barley 84c per bu., shelled corn 98c per bu., oats 56c per bu., linseed meal $55 per ton, silage $5.00 per ton, alfalfa $12.00 per ton, tankage $3.75 per cwt., pork credited at $10.50 per cwt. Two pigs per lot.

FIND ABORTION GERM INFECTS FOWLS

Egg Production Is Lowered by Disease and Birds Often Die

M. W. EMMEL, BACTERIOLOGICAL SECTION

Thirty-three years ago Bang, a Dane, isolated an organism causing abortion disease in cattle. Bruce had already found an organism which was the cause of Malta fever in the goat. Then, 15 years ago, Traum isolated an organism in Iowa which was responsibl for abortion disease in swine. These three organisms, *Brucella abortus, Brucella melitensis,* and *Brucella suis,* have since assumed a place of vital economic importance to the farmer. An eminent authority has recently estimated the annual loss in the United States caused by these organisms to be $50,000,000. Within the last few years they have been found to be of additional importance as they have been definitely shown to be responsible for undulant fever in man.

Recent experiments at this Station have proved that these organisms must now be regarded as also producing a serious infection in the fowl. Experiments extending over a period of two years in which a total of 48 birds were exposed artifically to these organisms produced infection in all but a few birds.

The experimental birds were exposed to the infection in various ways. Milk from the infected udder of the cow, portions of an aborted foetus, and pure cultures of the three members of the genus, isolated from man as well as animal, all produced infection. Two birds were fed one-half pint of infected milk for five days, and, although the birds became infected, recovery took place. It is very likely that continued feeding would have produced a more severe infection.

There seemed to be no difference in the ability of the three organisms to produce infection in the experimental birds. Death was produced in many cases, a few recovered from the infection, while others were killed at intervals in order to study the various stages of the disease.

An agglutinatioı test has been developed for the determination of the infection in other animals. This test applied to the fowl has a high degree of accuracy but is not an unfailing criterion of infection because during the last stages of the infection the birds do not react.

The course of the disease is rather variable. Death may ensue from 18 to 96 days. The birds first show a diarrhea, a paleness about the head, comb, and wattles, and gradually lose weight. The birds become very weak and often show paralysis before death. The presence of these symptoms appears to be very constant. Diagnosis is somewhat complicated by the fact that the lesions found in the organs are rather variable.

One of the most important and interesting features in connection with the work with this disease was the finding of natural infection in four flocks. The owners of three of these flocks desired their flocks tested for bacillary white diarrhea because they had fallen off in egg production. A very small percentage reacted to the test for bacillary white diarrhea while an average of 20 per cent reacted to the test for the abortion germ. Three birds suffering from the infection were received for diagnosis from

a fourth flock. This flock contained a large number of birds. Thirty had died and 10 were sick, all showing the symptoms described above. Egg production had dropped from 80 per cent to 65 per cent. Sixteen birds from these flocks were studied in the laboratory and found to have the infection.

Although death may not be produced in all cases, this infection is of great economic importance, due to the decreased egg yield from infected flocks. Birds experimentally infected soon went off egg production. Flocks naturally infected had a history of decreased egg yield and birds from these flocks studied in the laboratory all showed inactive ovaries. If recovery does take place, it is very slow and as long as six months may elapse before the bird again becomes productive.

WHEAT SCAB DAMAGES MICHIGAN GRAIN CROPS

Favorable Weather Conditions Increase Danger of Damage by This Disease

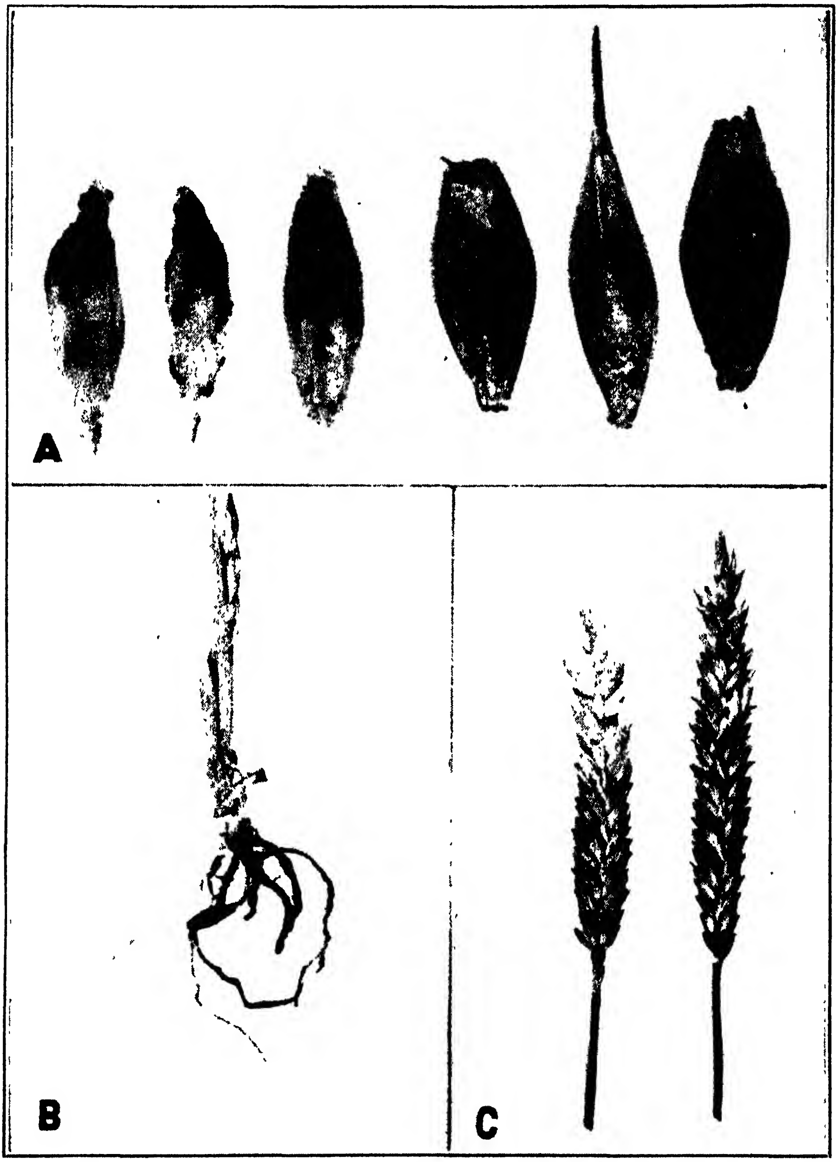
RAY NELSON, BOTANICAL SECTION

Because of the abundance and distribution of rainfall, the season of 1928 was very favorable for the development of many plant diseases which, under ordinary conditions, are relatively unimportant. Among the diseases of grain crops, wheat scab does not cause much loss except under weather conditions similar to those of last year. Barley, rye, oats, and wheat were affected to an unusual extent by the scab fungus.

The unusual amount of this disease in these crops last year made it necessary for farmers to use a great deal of seed grain which was affected with *Gibberella saubinetti*, the scab fungus. The use of this scabby seed resulted in the occurrence of seedling blight during the past spring and reports indicate that the disease is again developing to an unusual extent upon the heads. A short description of this disease with some timely information about methods of reducing scab infection is the purpose of this discussion.

The scab disease of grain crops is caused by the fungus *Gibberella saubinetti* which produces two spore stages, only one of which is usually found in Michigan. Scab first appears upon the heads when the grain is about half ripe. The fungus is seen first as a white mold on the spikelets, the bases of the glumes, and the rachises. Later the pink spore masses of the fungus, the *Fusarium* stage, form salmon-colored incrustations on various portions of the spikes, especially the bases of the glumes. These salmon-colored spore masses are made up of the conidia of the fungus and are a reliable means of identifying the disease. The portions of the spikelets which are attached ripen prematurely and turn yellow or brown before the normal parts mature. When the heads have ripened, the diseased parts are shrunken, the grain is shriveled, and covered with a thick felt of mold and spores of the fungus. Such seed is usually low in viability.

Barley was severely affected in 1928 and seed barley in many cases was of very poor quality. On black barbless barley the perithecial



A—Black barbless barley from Gratiot county with perithecia (left) and conidia (right) developed on the glumes.
B—Seedling blight of oat due to the scab fungus. Most of the roots are attacked and decaying and the fungus has produced perithecia on the hulls of the old seed.
C—Scab on beardless wheat. The upper half of the head to the left is diseased. Salmon-colored conidia are present in great quantities on the spikelets.

stage of the fungus, a form more resistant to drying and other external factors, was formed in abundance. This stage of the fungus has rarely been found in Michigan and its development last year was due to the very congenial weather conditions for the disease. Both the perithecial and conidial stages of the fungus developed profusely on the glumes and the fungus was thus strongly intrenched for the attack this year. Wheat, oats, and rye were similarly affected but apparently much less than barley.

The use of this scabby seed resulted in the occurrence of considerable seedling blight, especially in the barley and oat crop. A number of reports were received of seedlings turning yellow and dying when only a few inches tall. Examination of these seedlings invariably has shown the presence of the scab fungus. The blighting of the seedlings is due to the scab fungus attacking the roots of the young plant. The resulting root rot causes the death of a portion or of the entire seedling, depending upon the extent of the root system involved and upon weather conditions.

The scab fungus is also the cause of root rot in corn, and numerous observations, with cumulative experimental evidence, have established the relation between corn root rot and scab of the grain crops. Where wheat follows corn in the rotation it has been determined that scab is much more likely to cause damage than where wheat does not follow corn. It has been found advantageous to plan a rotation so that wheat neither precedes nor follows corn. The scab fungus forms its spore stages on the old corn stubble in the field and the advantage of planting some crop after corn that is not susceptible to attack is thus obvious.

With this disease again developing to a greater extent than usual, the prospects are that much scabby seed will again be used this fall and next spring. Every effort should be made to prevent damage to the 1930 grain crop for no one can predict what weather conditions will be at susceptible periods in the growth of the crop. Wheat should not be planted after corn and should not follow any other grain crop. High grade seed which is free from shriveled grains should be selected, thoroughly dried, and stored under the most favorable conditions until ready to be sown. Wheat should be treated with copper carbonate* for

*The standard method for the control of stinking smut consists in coating the grain with copper carbonate at the rate of two ounces of the dust to each bushel of seed. Any simple form of container in which a thorough coating of the grain with the chemical can be obtained is satisfactory for this treatment. Usually an old barrel churn is the best form of container for treating small quantities. The wheat is dumped into the churn, the dust added at the rate of two ounces for each bushel of seed and the mixture agitated for two or three minutes. For larger quantities a barrel with canvas tied over the mouth is useful. The dust is added to the measured amount of grain, the canvas is tied securely, and the barrel is rolled up an incline. When the dusting is complete, the grain is dumped and is ready to be sacked.

Wheat treated with copper carbonate can be held safely for a day or so, should an interruption in the planting operations be necessary. This is one of the marked advantages over the formaldehyde treatment which requires that the grain be sown the same day that it is treated.

In treating large quantities of grain in closed rooms with the copper carbonate, care should be taken not to inhale the dust. Some form of protection in the way of a simple dust mask is advisable. When treating grain in the open where there is a breeze, this is not necessary.

the prevention of stinking smut and the grain seeded within the period recommended as most favorable for each section of the State. Extremely late seedlings should be avoided since conditions at that time are usually more favorable for smut infection and seedling blight. Attention to seed bed preparation and proper fertilization to insure prompt germination and a stand of strong seedlings will decrease the chances of damage from scab and smut.

MANY FACTORS CAUSE ABNORMAL MILK FLAVORS

Pasture Conditions, Certain Feeds, or Animal's Condition Affect Quality of Milk

P. S. LUCAS, DAIRY SECTION

Off flavors in milk are more likely to be present in Michigan during the spring and autumn months than at other times of the year. They are due both to the changes in feed common to those periods and to the bacterial flora of the milk at those seasons. To a lesser degree they may be caused by the physical condition of the cow and to methods of handling milk.

To determine more readily the source of abnormal flavors, it is convenient to classify them into two groups, which are flavors present when milk is drawn, and, flavors developing after milk is drawn.

In the first group, the cause of the flavor may be the feed or the physical condition of the cow. Flavors of this type may always be distinguished from those of the second group by the fact that they are present when the milk is drawn and do not become intensified as the milk is held. Those of the second group have as their source the products of bacteria not commonly found in milk but which may have gained access to the milk, or to strongly flavored materials stored near unprotected milk.

Feed of the Cow

A change in the flavor of milk is always noticeable in the spring when cattle are changed from hard feeds to pasture. Usually this change is made too abruptly, with the result that the cow's system is somewhat upset. The so-called "June flavor" of butter is due to feed, and, when the cows are first placed on pasture, this flavor may be so pronounced as to become slightly disagreeable. If cows are turned on pasture for short periods only at first, much of this difficulty will be avoided.

The seasons bring changes in the nature of the feed when cows are on pasture alone. One of the worst of the feed flavors in certain sections of Michigan is that caused by the wild onion. About the only practicable method of dealing with this problem is to destroy the weed or keep the cows off the onion-infested pastures. The onion

flavor can be removed from milk but the required apparatus and process of removal is so costly that it is impracticable except in the very largest dairy plants. The feeding of onion tops or leeks will cause the same highly disagreeable flavor.

The greater prevalence of weeds in pastures as the season advances is often the cause of undesirable "weed" flavors in the early fall. Chief among the offenders is the ragweed. Other weeds capable of producing undesirable odors are mares tail, horse weed, scouring rush, dog fennel, worm weed, foxglove, buckhorn, wild lettuce, wild tansy, beardtongue, and boneset. When these weeds become rank in their growth, it is good practice to mow the pasture, setting the mower cutter bar high. Renewal of pastures at two year intervals is also good practice in controlling weeds.

Even the common feeds are responsible for certain changes in the flavor of milk. Silage affects the flavor very appreciably though not unfavorably, unless the silage is partially decayed. In a survey made at the University of Illinois Experiment Station, some 60 per cent of consumers prefered milk carrying a silage flavor. Alfalfa hay gives to milk a rather pronounced flavor, but it is objected to by only a very few people. Cull beans give both milk and butter an undesirable flavor if fed in considerable amounts. Green rye and green cow peas affect the flavor but very slightly. Turnips, if fed at rates of 15 pounds or more, an hour before milking, cause undesirable flavors, as does green alfalfa if fed in amounts as large as 30 pounds. The feeding of sugar beet tops, also, has a bad effect, although the practice is rather prevalent in those sections where beets are grown. Pumpkins, rape, and cabbage cause characteristic odors in milk that are objected to by the average consumer.

Absorbed Flavors

Milk possesses great absorptive powers towards flavors. If it is allowed to stand exposed to odors they are readily taken up. These may be barn odors, fruit or vegetable odors, and those of drugs, chemicals, or fly sprays. The obvious remedy is to store the product in a place free from such odors immediately after milking. These flavors of course are not present when the milk is drawn but appear later, a fact of use in searching for the source of the abnormal flavor. Several complaints have this year been reported to the college from the use of fly sprays of pronounced odor, many of which were probably due to carelessness in handling the spray and allowing a small amount to get into the utensils.

Bacteria as a Source of Flavors

Bacteria which are not normally present in milk may be causative agents of a variety of disagreeable flavors. The common lactic acid bacteria cause souring of milk by the formation of lactic acid. "Barny" flavors are often due to the action of bacteria of the peptonizing and liquifying groups associated with manure. Among the less common bacteria causing abnormal fermentations are those causing soapy, malt, bitter, fishy, unclean, fruity, yeasty, and moldy flavors. Strict cleanliness, sterilization of utensils, and holding milk at low temperatures are methods for prevention of these flavors.

Physical Condition of the Cow

In order that a cow may calve at a period when milk prices are highest, it is not uncommon that the lactation period is extended abnormally. When this period exceeds 10 months, the milk may take on a rancid and often a bitter taste. This taste is present when the milk is drawn. In such cases it is best to "dry up" the cow. If the trouble persists in the next lactation period the cow should either be sold or, if valuable, used as a nurse cow.

Certain diseases, especially mammitis, garget, and mastitis, may affect the cow in such a manner that milk of disagreeable taste is secreted. Indigestion will often produce the same results.

When milk is judged at contests, a perfect score of 25 points is allowed for flavor. Some idea may be gained of the relative damage done to milk by the development of off flavors by examining the scores given for milk with bad flavors. The scores listed below are the usual ones allowed for milk having the off flavors named.

Flat, insipid, or watery	22 points
Strong or bitter	21 points
Salty, cooked, or smothered	20 points
Barny, cowy, weedy, or slight silage	19 points
Silage, feed, strong, barny, or musty	18 points
Rancid	15 points
Garlic, or approaching sourness	10 points
Sour or disinfectant taste	0 points

ELECTROPURE PROCESS REDUCES BACTERIA IN MILK

Use of Electric Current Seems Feasible Means of Improving Quality of Milk

E. D. DEVEREUX, BACTERIOLOGICAL SECTION

The electropure process for the treatment of milk has attracted some attention in recent years. Both producers and consumers of milk should be informed about this process and the results that may be expected from its application.

The milk to be treated first passes through a preheater and the temperature is raised to about 120° F. (48.9° C.) and is then pumped through the Electropure machine. In the machine, the milk flows through a vertical chamber, the dimensions of which are about 3½ x 4 x 24 inches. Carbon electrodes compose the 4-inch walls and insulating material the 3½-inch walls. As the milk flows through, it is subjected to an alternating electric current of 220 volts. The resistance offered by the various electrolytes in solution in the milk immediately causes the liberation of heat sufficient to effect a reduc-

tion of approximately 99 per cent in the bacterial plate count of the milk without altering the taste of creaming ability of the milk. Some recent experimental work at this station indicates that probably some other factors are also responsible for this reduction.

The final temperature of the milk is controlled by the rate of flow through the machine. From experimental data and actual practice, a temperature of 160° F. (71° C.) has been found to be very efficient. This temperature is not reached until the milk has travelled about two-thirds of the length of the column, and it is exposed to this temperature for only 15 to 20 seconds. The milk on leaving the machine flows over the preheater and cooler to the bottling machine. From the brief description of the Electropure unit, one can readily see that it is very small and compact. The machines are equipped with temperature control devices which eliminate manual control of the rate of flow of the milk.

In 1909, Stone (1) found that a current of 1.0 to 0.6 milliamperes stimulated the growth of microorganisms in milk and water, and heavier charges caused a decided decrease in the number of bacteria. A very rapidly alternating current was used by Beattie in 1916 (2) for treating milk for infant feeding. A temperature of 140° F. (60° C.) was reached and a reduction of 99.93 per cent in the bacterial content was found. Anderson and Finkelstein (3) in 1919 conducted extensive studies on the pasteurization of milk by means of a high voltage current which they termed the "Electro-pure Process." A temperature of 158° F. (70° C.) was used. They concluded that the process gave a satisfactory reduction of the total count of bacteria in the milk and that the creaming property and food values were not altered. This work was confirmed by Prescott (4) in 1927 in an investigation that extended over one year on a plant which used the electrical process. Doan (5) also found this process to reduce the bacterial count of milk satisfactorily.

Since the machinery for the Electropure process has progessed in perfection, a group of papers by individuals and committees from New York, Pennsylvania, and Michigan have appeared concerning the destruction of pathogenic bacteria by the process. These papers have been bound together in the form of a book (6). The conclusions reached by these workers as a group were that when a temperature of 160° F. (71° C.) was used the organisms causing the following diseases (all that were tried) were destroyed: typhoid fever, para-typhoid fever, diphtheria, scarlet fever, septic sore throat, tuberculosis, infectious abortion, and Malta fever.

The data in the above mentioned group of papers were collected from machines operating on a commercial scale. During the past year, experimental work has been conducted at this Station (7), using a small laboratory model of the Electropure machine, and it was found that the pathogenic organisms mentioned above, when inoculated into milk, were readily destroyed. Some organisms that are common to milk have the ability of being able to form very resistant spores. Some pathogenic organisms, such as the anthrax bacillus, also have this power. A number of these spore-forming organisms, including the anthrax bacillus, while in the spore stage, were inoculated into milk and the milk processed in the laboratory machine. The spores were reduced in numbers in different trials from 71.5 to 99.9 per cent, while the re-

duction in tubes, pasteurized by a method analagous to steam pasteurization except that it was on a small scale, displayed reductions of 0 to 13 per cent. It is in connection with the destruction of spores that other factors are thought to play a part in addition to the heat liberated because of the resistance offered by electrolytes. Further experimental work on this phase of the problem is being planned.

In conclusion, the convenience and simplicity of the machine and the efficient manner in which it reduces bacterial populations and destroys pathogenic organisms in milk without altering the taste or creaming ability of milk make the electropure process one worthy of further consideration by the producer, the consumer, and the investigator of dairy products.

References

(1) Stone, Botanical Gazette, 48(1909) 359.
(2) Beattie, J. M., Jour. of State Medicine, 24(1916) 97.
(3) Anderson, A K. and Funkelstein, R., Jour. of Dairy Science, 2(1919) 374.
(4) Prescott, S. C., Amer. Jour. Public Health, 17(1927) 221.
(5) Doan, F. J., Penn. Ag. Exp. Sta. Bul. No. 213, July, 1927, p. 22.
(6) Pathogenic Experiments Performed Upon the Electropure Process, Tanki Mail Advertising Service, Pittsburgh, Pa.
(7) Gelpi, A. J., Jr., and Devereux, E. D, Effect of the Electropure Process of Treating Milk upon Bacterial Endospores. (To be published.)

SAMPLES OF SPOILED MAPLE SYRUP WANTED

F W FABAIN, BACTERIOLOGICAL SECTION

The Bacteriological Section of the Experiment Station has been studying the causes of spoilage in foods for many years. Studies have been made of canned fruits and vegetables and the results have been published in bulletin form and in magazine articles. Recently, detailed study was made of the cause of honey spoilage and the results are now available in Technical Bulletin 92.

The department desires to continue this type of study and to extend it to other products. The next product which will be studied is maple syrup. In order to best study spoilage in maple syrup, a large number of samples of fermented or spoiled cans should be available.

It will be greatly appreciated if readers of the **Quarterly** who have such samples available will send them to the Bacteriological Section, Michigan State College Experiment Station, East Lansing, for use in this work.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.
289 Corn Growing in Michigan.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
80 Yellow Rocket (a dangerous weed).
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
109 Dependable Michigan Crop Varieties.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.

133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management for Commercial Apiaries.
136 The Muck Soils of Michigan.
138 Rural Highways.
139 Tourist Camps.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
168 The Management of Michigan Muck Soils for Onion Production.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
178 Michigan Raspberry Diseases.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.

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†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

182 Strawberry Growing in Michigan.
184 Size of Peaches and Size of Crop.
185 Roadside Marketing in Michigan.
186 Chrysanthemum Breeding.
***188 Pollination of Orchard Fruits in Michigan.**
***189 The Marketing of Michigan Milk.**
***190 Oak Forests of Northern Michigan.**
***191 Barley for Michigan Farms.**

Circular Bulletins—

34 More Wheat for Michigan.
47 Poisoning from Bacillus Botullinus.
48 Spraying for Hopperburn.
49 The Hessian Fly.
50 Hairy Vetch.
53 Standard Fertilizers for Michigan.
55 Lime Requirement for St. Joseph County.
56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
67 The Cherry Maggots.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
86 Cherry Fruit Fly.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.

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92 Garden Flowers.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
98 How to Make and Preserve Cider.
100 Michigan Farmers Tax Guide.
101 Cockroaches, Silver-fish, and Book-lice.
102 Farm Lease Systems in Michigan.
103 Prevention of Wind Injury to Crops on Muck Land.
104 Clothes-Moths and Carpet Beetles.
105 Sweet Corn.
106 Flies Commonly Found in Dwellings.
107 Mexican Bean Beetle.
108 Organic Matter in Berrien County Soils.
109 Organic Matter in Ingham County Soils.
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113 Organic Matter in Calhoun County Soils.
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117 Distribution of Acid Soils, Muskegon County.
118 Distribution of Acid Soils, Jackson County.
119 Distribution of Acid Soils, Hillsdale County.
120 Distribution of Acid Soils, Ingham County.
121 Distribution of Acid Soils, Kent County.
122 Distribution of Acid Soils, Tuscola County.
***123 Farm Milk Houses.**
***124 The Young Vineyard.**
***125 The Mint Flea Beetle.**
***126 Essentials of a Mulch Paper Laying Machine.**

Quarterly Bulletins—

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Extension Series Bulletins—

2 The Babcock Test.
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17 The Stinking Smut of Wheat.
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
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58 Culling the Farm Flock.
59 Methods of Control for the European Corn Borer.
60 Insect and Disease Control in the Home Orchard and Vegetable Garden.
67 Producing Sugar Beets.
68 A 10′ x 12′ Portable Brooder House.

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69 A Simple Electric Water System.
70 Soil Management for Profitable Corn Production.
71 Wiring the Farmstead.
72 Value and Care of Farm Manure.
73 Barley, Cull Beans, and Potatoes as Feeds for Dairy Cattle.
74 The Fruit Bark-Beetle.
75 The Oriental Peach Worm.
76 Some Common Sucking Insect Pests of Evergreens.
77 The Tar-Paper Packing Case for Wintering Bees.
78 The Fruit Tree Leaf Roller.
79 Apple-Maggot.
80 Grape Root-Worm.
81 Growing Lima Beans for the Canning Factory.
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84 Growing Sweet Corn for the Canning Factory.
***85 Dairy Goats.**
***86 Sheep Raising in the Upper Peninsula.**

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3 Bean Club Work.
5 Pig Club Work.
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9a Clothing Club Work.
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12 Hot Lunch Club.
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***18 Poultry Club Project.**

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21 How Contact Insecticides Kill.
32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
40 Physiological Balance in the Soil Solution.
48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.
62 Some Physical and Chemical Properties of Several Soil Profiles.
64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.

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65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).
66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
67 Investigations on the Blackleg Disease of Potato.
68 Bacterium Pullorum.
69 The Fruiting Habits and Pruning of the Concord Grape.
70 The Nutrient Requirements of the Strawberry.
71 Growth of Lettuce as Influenced by Reaction of Culture Medium.
72 Potato Spraying and Dusting Experiments in Michigan.
73 Adsorption by Activated Sugar Charcoal.
74 Effect of Nutrient Conditions on Colloidal Properties of Certain Vegetable Crops.
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81 Storage and Transportational Diseases of Vegetables Due to Suboxidation.
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88 Investigations on Winter Wheats in Michigan.
89 Ultimate Effect of Hardening Tomato Plants.
90 The Breeding of Strains of A-Tester Yellow Dent Corn.
91 Taxes on Michigan Rented Farms.
92 A Study of the Cause of Honey Fermentation.
93 Observations on the Pathology of Bacterium Abortus Infection.
94 A Study of Gelatins and Their Effect on Ice Cream.
95. Studies in Flax Retting.
***96 A Local Farm Real Estate Price Index.**
***97 Studies of the Overwintering and Modes of Infection of the Fire Blight Organism.**
***98 Further Studies on the Values of Non-Virulent Living Culture Vaccination of Cattle Against Brucella Abortus Infection.**
***99 Defective Graft Unions in the Apple and Pear.**

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Circulars are briefly and concisely written discussions of a popular nature.

Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during Feb· iary, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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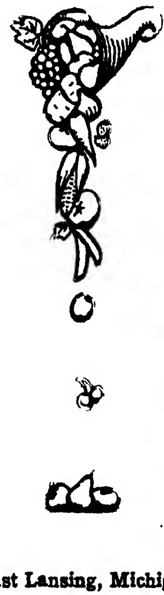
SUB-STATIONS

Chatham, Alger County, 780 acres deeded, G. W. Putnam, Director.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded, S Johnston, Superintendent.
Graham Station, Kent County, 50 acres donated by R. D. Graham; 50 acres purchased, H. M. Wells, Superintendent.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded, Putnam Robbins, Superintendent
Lake City Experimental Potato Farm, Missaukee County, 640 acres purchased or under contract, Ashley Berridge, Superintendent.
Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W K. Kellogg; George Getman, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

THE

QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science



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CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XII, No. 2, November, 1929

IT PAYS TO PROTECT BEES IN WINTER

Windbreaks for Apiaries and Insulation for Colonies Are Needed in Michigan

R. H. KELTY, HORTICULTURAL SECTION

The period when the bee colony needs insulation from cold may be divided into two parts: first, the broodless period from November 1 to March 15, approximately, and second, from March 15 to the time when danger of frost is past, during which period the colony is normally engaged in the rearing of brood. The reason for considering the two periods separately is that during the broodless period, the bees attempt to maintain a temperature of about 57° F., but, during the time that broodrearing is going on, a temperature of from 93°-96° is constantly maintained by physical exertion and digestion of honey by the bees. The need for insulation against cold is therefore greater, in late winter and spring when brood rearing is going on.

Experiments conducted in the College Apiary indicate that, though the average farmer gives his bees insufficient packing, or none at all, it is also possible to over-insulate a colony of bees in localities having medium ranges of winter cold. In the course of these experiments, colonies were prepared for winter with and without a windbreak, and with varying amounts of insulating material ranging from none at all to a packing case allowing four inches of insulation beneath the hive, six inches on the sides and from eight to 12 inches on top.

The results obtained show that a windbreak, such as would be afforded by a hedge, a group of bushy shrubs or evergreen trees, or a group of buildings, is essential to good wintering of bees. If no natural windbreak is available it will be profitable to erect, at least on the north and west exposures, a slatted fence of boards six to nine feet high, spaced two inches apart. It is a better practice to build a fence on all four sides of the apiary. Bees which have such protection from the wind are benefitted greatly in winter, as indicated by reduced consumption of honey and lessened expenditure of energy in heat generation, but the greatest benefit of the windbreak is apparent in spring after broodrearing is commenced. Though the windbreak is particularly beneficial to unpacked or poorly insulated colonies, its effect on bee activity from fully packed colonies is pronounced. On windy days when the temperature is high enough for bee flight, say 60° to 70°, colonies in windswept locations have few bees leaving the hive. On such a day a windbreak was erected on two sides of an apiary and

twenty minutes later bees were flying freely from all colonies. This fact is significant to fruit growers who use bees for pollination in orchards.

The amount of insulation needed to protect the colony which is wintered out of doors, depends on the temperature range during winter to a considerable extent. For localities where winter temperatures seldom fall below zero, a moderate amount of insulation such as is furnished by commercial double walled hives with chaff trays or by the tar-paper packing case gives good results. In northern Michigan where the temperature is considerably below zero for days at a time, more insulation is an advantage. However, colonies given as much insulation as is afforded by the standard wooden packing case, namely four inches on the bottom, six inches on the sides and eight or 12 inches on top, should not be placed in the packing cases in fall until broodrearing has entirely ceased and should be unpacked as soon as danger of frost is past in spring. Otherwise, unless an adjustable entrance is arranged to prevent "hanging out," an over-heated condition in the broodnest may result which is detrimental to colony development.

Colonies packed in standard wooden packing cases may consume considerably less honey during the winter and spring period than colonies in either tar-paper cases or double-walled hives. However, they may also produce a correspondingly smaller broodnest, with the result that a smaller honey crop will be gathered. If sufficient insulation to prevent *rapid* changes of temperature within the hive is given, those colonies which have medium amounts of insulation, such as is provided by the tar-paper packing case, will respond more quickly to occasional warm days in late March and April and will develop a larger broodnest if other factors such as age and prolificacy of the queen, amount and age of bees present, amount of food present and presence of a windbreak are equal than will colonies which have the insulation of a wooden packing case.

Colonies wintered without packing or insulation, but with a good windbreak, were in good condition April 1, but had consumed considerably more honey than well insulated colonies. The crop produced by these colonies during the past season was one super less than the average for the apiary. The extra super of honey would have covered the cost of packing these colonies for ten years. However, in the winter of 1927-28, which was relatively mild, unpacked colonies made a much better record, in some cases gathering a crop greater than the average for the apiary and particularly for certain over-insulated colonies which were packed early and unpacked late and which reared brood a large portion of the winter and were in very poor condition in spring.

It is concluded that for average winter conditions in central and southern Michigan, moderate insulation will give satisfactory results. The tar-paper packing case meets these requirements, providing sufficient insulation at the very moderate cost of about 15 cents per colony.

For the more severe winters of northern Michigan, wooden packing cases or tar-paper cases, using a three-inch rim around the hive at the bottom will afford better protection. Properly constructed bee-

cellars are satisfactory anywhere in the state, but one should certainly provide a windbreak for the apiary, because colonies are removed from the bee-cellars about April 1 and are usually not given other insulation during the spring.

No colonies which do not have a vigorous queen, from three to five pounds or more or young bees, and at least 50 pounds of well ripened white or light amber honey should be placed in winter quarters. It is good insurance to feed all colonies about a gallon of sugar sirup before packing the bees. The sirup should be made in the proportion of two pounds sugar to one pint of water. Feeding is especially needed if there is any question regarding the quality of the honey in the hive.

FEEDING VALUE OF ALFALFA HAY IS VARIABLE

Protein Content Affected by Maturity at Cutting and Other Factors

C. F. HUFFMAN, DAIRY SECTION

The value of alfalfa hay as a feed for dairy cattle depends largely on its high protein content. Rations of milking cows and growing animals in Michigan are more likely to be deficient in protein than in any other food constituent. This is due to the fact that most home grown feeds, especially the cereal grains, are low in protein and high in energy. The protein of alfalfa is needed to balance these home grown feeds. However, the protein content of alfalfa hay varies widely, as indicated by the chemical analyses reported in the following table.

Table I.—Showing protein, calcium, and phosphorus content of alfalfa hay grown on the College farm and vicinity.

Sample	Protein Per cent	Calcium Per cent	Phosphorus Per cent
1	12.25	1 86	133
2	14 44	2 05	.147
3	13 50	1 21	170
4	14 75	1 49	250
5	12 81	1 41	220
6	13 81	1 08	230
7	16 07	1 50	240
8	17 68	2 14	171
9	18.94	1 73	211
10	19 34	1 82	.232
11	12 63	1 28	120
12	13 50	1 31	.135
13	20 00	1 69	.158
14	14 25	1 02	220
15	20 25	2 01	198
16	12 50	.	.130
17	12 50	.	.130
18	13.50	1.13	.170
19	14 50	2 45	.127
Maximum	20 25	2.45	.250
Minimum	12 25	1 02	120
Average	15 12	1.60	.178

These samples of alfalfa hay were secured from the college farm and from various farms in the vicinity of East Lansing. The analyses were made by the Agricultural Chemistry Section. The samples were fairly uniform from the standpoint of color and purity. The sample of alfalfa showing the maximum amount of crude protein contained 160 pounds more protein per ton than the sample with the minimum protein content. This extra protein is equivalent to that supplied by 470 pounds of old process linseed oil meal.

There are several factors which are known to affect the composition of alfalfa hay, such as maturity when cut, method of making hay, the cutting, moisture, variety, and probably many other causes.

The most important factor affecting composition is the maturity of the alfalfa at the time of cutting as shown in the following table.

Table II.—Showing the composition of alfalfa hay at different stages of maturity.*

Alfalfa	Water	Ash	Crude Protein	Fiber	Nitrogen Free Extract	Fat
Before bloom	6.2	10.0	22.0	20.5	37.1	4.2
In bloom	7.5	10.0	15.0	30.2	35.5	1.8
In seed	10.4	7.0	12.2	27.6	40.3	2.5

It is apparent that alfalfa cut in early bloom contains more protein than alfalfa cut at a more mature stage.

The amount of leaves in the hay also affects the chemical composition. Leaves contain a large part of the nutrients as shown in the following table.

Table III.—Showing the relative composition of alfalfa hay, leaves, and stems.*

	Water	Ash	Crude Protein	Fiber	Nitrogen Free Extract	Fat
Alfalfa hay	8.6	8.6	14.9	28.3	37.3	2.3
Alfalfa leaves	6.0	13.6	22.5	12.7	41.2	3.4
Alfalfa stems	5.6	4.9	6.3	54.4	27.9	0.9

Alfalfa leaves carry from two-thirds to three-fourths of the crude protein present in the plant. This fact shows clearly the necessity of using methods of curing hay to prevent the loss of leaves.

There is but little difference in the chemical analyses of first, second, and third cuttings of alfalfa hay.

Certain food constituents may be lost when hay is damaged by rain. The Colorado Experiment Station reported the chemical analysis of a sample of alfalfa hay before and after being damaged by rain.

The greatest loss due to exposure to rain was in the crude protein content which is probably the most valuable part of the alfalfa plant so far as the nutrition of dairy cattle is concerned.

*Feeds and Feeding, Henry & Morrison. 18th edition unabridged.

Table IV.—Showing loss of nutrients from alfalfa hay due to exposure to rain.

	Ash	Crude Fiber	Fat	Crude Protein	Nitrogen Free Extract
No rain	12 18	26 46	3 94	18 71	38 71
Damaged by rain	12 71	38 83	3 81	11 01	33.64

Minerals in Alfalfa Hay

There is considerable variation in the calcium and phosphorus content of different samples of alfalfa hay as shown in Table I. The calcium ranged from 1.02 to 2.45 per cent with an average of 1.60. The phosphorus varied from 0.120 per cent to 0.250 with an average of 0.178 per cent. The variation in the calcium content is probably not important since the sample lowest in calcium when fed liberally would furnish a sufficient amount of this element for heavy milk production.

However, the variation in the phosphorus content of alfalfa is important. Depraved appetite, a craving for things not ordinarily classed as food, such as wood or bones, occurs among dairy cattle in certain sections of Michigan. This condition is usually due to a lack of phosphorus in the ration. It occurs frequently where low-phosphorus alfalfa hay is fed. Alfalfa in common with other roughages is inherently low in phosphorus. Consequently, in regions where depraved appetite occurs among cattle, rations consisting of alfalfa, corn silage, corn, and oats should be supplemented with phosphorus. Phosphorus may be supplied by feeding protein concentrates such as linseed oil meal, wheat bran, or cottonseed meal, or it may be supplied by feeding special steamed bone meal. Allow free access to a mixture of equal parts bone meal and salt.

PRELIMINARY BUDDING IS USEFUL IN CERTAIN CASES

F. C. BRADFORD, HORTICULTURAL SECTION

Recent investigations at various stations, indicating possible advantages in double working of some varieties of fruits, lend interest to methods of expediting the process. Under some circumstances, time can be gained by doing the work backward, thus adapting a method used years ago by Van Mons in distributing rare material. Buds can be inserted into small branches of the variety destined to serve as intermediary and these branches subsequently used as cions in grafting.

In the nursery of the Horticultural Department at East Lansing, pear cions containing pear buds inserted in August 1927 were whip grafted, in the spring of 1928, into the collars of pear seedlings in the nursery row. The subsequent growths were entirely satisfactory, four to five

feet, and fully equal to those made by unbudded cions. Though bench grafts on roots have not been tried by this method, there is every reason to assume that here, also, the budded cions would grow as well as unbudded, though, of course, no bench grafts will grow as well in the first season as those set on seedlings already established in the nursery row.

Preliminary budding is believed worthy of study in the propagation of ornamental material which roots with difficulty or grows slowly when propagated by cuttings.

PROTEIN SUPPLEMENTS DECREASE FEEDING COSTS

Concentrates Effect Greater Savings When Home Grown Grains Are High Priced

G. A. BROWN, ANIMAL HUSBANDRY SECTION

All grains are high in price at the present time and indications are that still higher prices will prevail before another harvest season. Every effort should be made to get the most possible out of the farm grains used with a minimum expenditure for high priced concentrates. When feeds are expensive, many producers hesitate to buy the higher priced protein concentrates. Where heavy grain rations are being fed, this is poor economy from the standpoint of maximum efficiency in the use of both feed and labor.

Experiments conducted at this station show a greater need for high grade protein supplements when farm grown grains, such as corn and barley, are high in price than when they are cheap.

On the College farm, there are now 15 pigs which have been fed only corn in a self-feeder on rape pasture. After 120 days on feed, these pigs average 157 pounds, having gained only .88 of a pound per head daily. They have consumed 418 pounds of corn per 100 pounds of gain at a feed cost of $7.31. Another lot of pigs placed on feed at the same time and given access to both corn and 60 per cent tankage with rape pasture were marketed September 24th, at an average weight of 184 pounds. These pigs made an average daily gain of 1.36 pounds per head and consumed 318 pounds of corn costing $5.56 and 17.6 pounds of tankage costing $.62 for each 100 pounds of gain, or a total feed cost of $6.18. Feeding protein supplement (tankage) in this case resulted in a saving of $1.13 in the feed cost of each 100 pounds of gain made by these pigs and reduced the labor cost incident to feeding them by more than one-third.

In the lamb fattening work last winter, 15 lambs fed shelled corn, alfalfa hay, and corn silage for a 90-day period gained 22.9 pounds each, or .286 pounds per head daily. Each 100 pounds of gain produced required 418 pounds of shelled corn, 517 pounds of alfalfa hay, and 402 pounds of silage.

A similar lot of lambs which were fed linseed meal in addition to the above feeds gained 29.5 pounds each or .368 pounds per head daily. For each 100 pounds of gain, this lot of lambs consumed 313 pounds of shelled corn, 44 pounds of linseed meal, 401 pounds of alfalfa hay, and 367 pounds of silage. Forty-four pounds of linseed meal effected a saving of 105 pounds of shelled corn, 116 pounds of alfalfa hay, and 35 pounds of silage in the production of each 100 pounds of gain.

The gains in the lot which did not receive a protein supplement were produced at a cost of $11.43 per hundredweight, and each lamb returned $1.60 above food cost. In the other lot which received a protein supplement the gains were produced at a cost of $10.04 per hundredweight, and each lamb returned $2.36 above feed cost.

Results obtained in fattening calves also emphasize the need of protein supplements. The addition of linseed meal to a ration of shelled corn, alfalfa hay, and corn silage resulted in an increased daily gain of .15 pound per head. As a result of the increased daily gains and greater efficiency in the use of feeds, the cost per 100 pounds of gain was slightly less where linseed meal was fed. The calves fed a protein supplement showed a higher finish, sold for $0.20 more per hundredweight, and returned $0.20 more for each bushel of corn fed.

In each case, the lower cost of gain and increased returns from feeding a protein supplement was due to higher finish and to increased efficiency of the ration, which resulted in less corn or other feed being required for 100 pounds of gain. When grains are high, as at present, it is all the more economical to supplement them with proper protein-rich feeds.

Caution must be used in the selection of protein rich supplements to be fed with home grown feeds. During the past 90 days, three lots of pigs have been fed shelled corn and ground oats, free choice in a self-feeder, and each lot has received a different protein supplement in a separate compartment of the feeder.

Lot I received corn, oats, and tankage. They gained 1.32 pounds per head daily and consumed 276 pounds of corn and oats and 42 pounds of tankage for each hundredweight of gain. The feed cost in this lot was $6.29 per hundredweight of gain produced.

Lot II was fed corn, oats, and a widely advertised commercial protein supplement and gained 1.14 pounds per head daily. They consumed 246 pounds of corn and oats and 114 pounds of the commercial feed. The feed cost in this lot was $8.84 per hundredweight of gain produced.

Lot III which was fed corn, oats and a second commercial feed gained 1.31 pounds per head daily and consumed 271 pounds of corn and oats and 84 pounds of the commercial supplement. The feed cost per hundredweight of gain in this lot was $7.49.

The literature put out by the manufacturers of both commercial supplements conveys the idea that these feeds are superior to tankage as a protein supplement to farm raised grains for swine feeding. The first commercial supplement was made up of six different feeds plus salt and charcoal. The second was made up of nine different feeds and contained, in addition, salt and potassium iodide, and was said to contain all necessary minerals. No salt or minerals other than those which might be contained in the feed were fed any one of the three lots.

All three lots were fed in the barn under carefully regulated conditions and the animals were given access to each feed in separate compartments of a self feeder. The two lots fed commercial mixtures ate twice as much of these feeds as Lot I ate of tankage in an effort to balance their ration but without satisfactory results, as indicated by the higher feed requirement and cost per hundredweight of gain in both lots when compared to the lot which was fed tankage. The slower gains in Lot II added very materially to the labor cost because a longer period was required to finish the hogs.

Results of this trial and previous trials conducted at this station have shown that the commercial mixtures used were not equal to either tankage or skim milk as a protein supplement to farm grains for growing fattening pigs.

In the light of present experimental knowledge, the Michigan producer in purchasing protein supplements should buy standard products such as tankage or fish meal for swine feeding and either linseed meal or cottonseed meal for sheep and steer feeding.

MAKE YIELD TABLE FOR SECOND GROWTH HARDWOODS

Enables Woodlot Owners to Determine Probable Harvest from Trees at Various Ages

A. K. CHITTENDEN, FORESTRY SECTION

It is sometimes asked how long it will take second growth hardwood forests to produce timber suitable for cutting or how much timber they will produce at a certain age. The number of years that must elapse before a given stand, say 20 years old, will reach usable size is a matter of interest to owners of forest lands. There is a large area of this type of forest in Michigan, the greater part of it being under 30 years old but with some older stands sufficient to furnish the basis for a study of its growth.

The original hardwood forest in the northwestern portion of the Lower Peninsula consisted of trees of many species and all ages mixed in together. The principal species were maple, beech, hemlock, elm, birch, basswood, and some white pine. In logging, often only the larger and more valuable trees were cut, and the smaller trees were sometimes removed later for distillate wood. Fire which ran through many of the cuttings still further thinned out the younger trees, leaving the land practically bare except for a few seed trees which escaped injury. From these seed trees, there came up a second growth of hardwoods differing somewhat in composition from the original forest. The white pine and hemlock had practically disappeared but the new growth contained a larger percentage of basswood because of its ability to sprout from the stump. The percentage of elm likewise increased

due perhaps to its light seed which are carried by the wind. Otherwise, the second growth resembles the original forest except that it is more even-aged due to its having started after a fire or cutting, although it contains here and there larger trees, survivors of the original forest.

Up to 40 years, the second growth hardwood forests have an even-aged appearance, the trees being about the same size. After that, the appearance gradually changes, the faster growing species like the elm and basswood outstrip the others until the forest seems to be uneven-aged although the larger trees may have all started about the same time. Young trees come up in openings that may occur and a 70 year old stand contains trees varying from very small sizes up to 14 inches in diameter.

The Forestry Department has prepared a table showing the probable average yield of these second growth hardwood stands. The table is based on 39 sample plots of one-fourth to one acre in size and applies to stands of mixed hardwoods that have come in after logging or fire in the northwestern portion of the Lower Peninsula. The yield in board feet is by the Scribner log rule and is calculated for trees 10 inches and over in diameter without allowance for cull.

Yield table for second growth hardwoods.

Age	Diameter breast high of average tree, inches	Height of average tree, feet	Average number trees per acre	Volume per acre, cubic feet	Volume per acre, cords	Volume per acre, board feet
20	3.1	30	1,480	1,410	15	....
30	4.7	43	795	2,050	22	....
40	6 2	52	465	2,635	29	....
50	7 5	58	330	3,160	35	....
60	8.7	62	263	3,625	40	....
70	9.7	65	223	4,025	44	11,400
80	10 6	68	195	4,375	48	12,500
90	11 4	70	170	4,685	52	13,700
100	12.1	72	150	4,960	55	14,800

It was not practicable to separate the plots into site classes but it is thought that the figures represent average soil conditions.

The table shows that timber suitable for sawlogs is not produced in less than 70 years. Distillate wood is produced at 30 years, giving 22 cords per acre at that age. At 70 years, the average diameter of the trees is 9.7 inches but there are many trees that are larger.

The second growth grows faster than the original forest because it has less overhead shade at first than have the young trees in a virgin forest of mixed species. The rate of growth of the new forests can be speeded up beyond that shown in the table by suitable thinnings. In many stands, crowding begins at an early age and, owing to lack of space for the development of the crowns, diameter growth is slow. A thinning should be made at about 40 years of age. The poorer species and crooked and defective trees should be removed to make more room for the stronger, thriftier trees of the best species. Some of the material taken out in this thinning will be suitable for cordwood but it will consist largely of the smaller trees, mostly those below the average diameter. The diameter growth of the trees left

standing will increase and while the number of trees per acre is reduced a greater yield in large trees will be obtained. Very heavy thinnings should not be made.

Where practicable, a light thinning can be made when the trees are about 20 years old, removing or breaking off the trees of poor species so as to reduce competition for soil moisture. A thinning at this age will not yield material of value but will result in faster growth of the trees left. A thinning every 20 years is desirable.

FARM BUSINESS STUDIED IN KALAMAZOO COUNTY

A Study of 49 Farms in Pavilion and Adjoining Townships During the 1928 Crop Year

F. T. RIDDELL, FARM MANAGEMENT SECTION

For the purpose of assisting in the farm organization problems of the general farms in southwestern Michigan, a farm business analysis survey was made of forty-nine farms in Pavilion and adjoining townships in Kalamazoo County, in April 1929. The facts obtained from the survey related to the organization and operation of the successful as well as the less successful farms in that area. Information was obtained and an analysis was made which should furnish suggestions to farmers for a more profitable organization and management of their business.

This area was chosen because the local conditions such as soils, topography, markets, and type of farming in general were quite similar to much of the general farming region of southwestern Michigan, especially Kalamazoo, Calhoun, and the northern part of St. Joseph counties. The major soil types* are Fox loam, Fox sandy loam, Bellfontaine loam, and Bellfontaine sandy loam. The sandy loams are usually less fertile than the loams. These four types constitute about 45 per cent of all the soils in Kalamazoo County. The topography is level to slightly rolling with a few hills. The soils in this area are usually sour.

The 49 farms were sorted on the basis of the high income and low income farms. Averages of the 16 farms having the highest income and of the 16 with the lowest are presented in Table I.

Farm Organization

The average farm was valued at $70 per acre, which does not appear to be inflated. The average size of farm operated was 155 acres, 90 of which were in the following crops: wheat, 24 acres; oats, 16 acres; corn, 15 acres; mixed hay, clover and timothy, 14 acres; alfalfa, 9 acres;

*The soil types are listed according to the classification of the Bureau of Soils, U. S. D. A. and Soils Section, Michigan Agricultural Experiment Station.

barley, 3 acres; potatoes, 2.6, and fruit, rye, alfalfa seedings and miscellaneous crops, 6.4 acres. In 1928, practically 60 per cent of the cash crop income was from wheat and 15 per cent prom potatoes. Under normal conditions, the income from potatoes would be larger.

A study of Table 1 will give a better picture of the crop arrangement on the most profitable and least profitable farms. As a whole, the kind of crops grown was very similar on these farms. However, the farmers with the greater income produced a greater percentage of feed crops and kept more and higher producing livestock.

The average farm kept 6 dairy cows, 11 ewes, 1 sow, and 75 hens which together with the young stock, made a total of 13 productive animal units* which is rather low for the size of farm operated. This provides only one animal unit for every seven acres of crop land.

Fig. 1. On the most profitable farms studied in Kalamazoo County, livestock was responsible for 65 per cent of the total farm income, with dairy cattle providing 63 per cent of the livestock income.

The average investment of the 49 farms was $12,101, of which 78 per cent was in land and buildings, 7 per cent in machinery and equipment, 12 per cent in livestock and 3 per cent in feeds and supplies. Cattle represent 55 per cent of the investment in livestock, horses 20 per cent, sheep 12 per cent, hogs 6 per cent, and poultry 7 per cent.

Farm Income

The average gross farm income for the 49 farms was $2,501, for the 16 high income farms it was $3,528, and for the 16 low income

***Productive Animal Units:** An animal unit is the amount of any kind of livestock kept for one year that will eat about as much feed as one cow. Each of the following is therefore considered to equal an animal unit: one cow, steer or bull; two heifers; two cattle fattened or wintered; four calves; two colts; five brood sows; 14 hogs raised; seven ewes or bucks; 20 sheep or lambs fattened or wintered; and 100 poultry (work horses are not included in productive animal units but are considered as farm power).

TABLE 1.—FARM BUSINESS ANALYSIS ON 49 FARMS
Pavilion and Adjoining Townships, Kalamazoo County
CROP YEAR 1928

	Your farm	Average of 49 farms	Average of 16 most profitable farms	Average of 16 least profitable farms
Size of Farm (Average)		155	150	155
Capital Investment—Total	$	$12,101	$12,489	$12,830
Land and buildings		9,405	9,229	10,337
Machinery and equipment		881	920	992
Feed and supplies		399	403	364
Livestock		1,416	1,937	1,137
Horses and mules		294	307	287
Cattle		773	1,210	599
Sheep		167	197	86
Hogs		89	107	71
Poultry		93	116	94
Receipts and Inventory Increases	$	$2,501	$3,528	$1,713
Crop income		834	939	679
Livestock income		1,523	2,309	959
Horses and mules		-7	-8	-1
Cattle		900	1,465	595
Sheep		177	224	68
Hogs		241	277	147
Poultry		212	351	150
Other income		144	280	75
Expenses	$	$1,423	$1,585	$1,371
Hired and family labor		272	243	290
Machinery depreciation		186	195	202
Buildings depreciation		100	108	111
Other current expenses		865	1,040	768
Farm income (receipts less expenses)	$	$1,078	$1,943	$342
Interest on investment at 5%		605	624	642
Operator's earnings		473	1,319	-300
Expenses per $100 receipts and net increase		57	45	80
Size of Business:				
Productive man work days		398	466	373
Number of livestock units		13	16	11
Number men (equivalent)		1.5	1.4	1 5
Number power units		4.3	3 8	4 9
Acres in farm operated		155	150	155
Acres in crops		90	89	89
Capital invested	$	$12,101	$12,489	$12,830
Crop Data (acres most common):				
Corn		10-16	13-24	15-25
Wheat		12-20-30	15-30	17-26
Potatoes		0-6	2-4	2-4
Barley		0-5	0-4-10	0-5-10
Oats		11-16-25	8-16-21	8-17-22
Alfalfa		0-11-25	0-12-20	0-10-30
Clover, timothy, and mixed hay		0-12-25	0-12	0-13-29
Livestock Data:				
Cows, average number		5 8	7 7	4 8
Sows, most common		0-1-3	0-3	0-1-3
Ewes, most common		0-30	0-30	0-37
Hens, average number		75	92	76
Measures of Efficient Production and Management:				
Crops: Yield per acre				
Wheat		17	19	15
Potatoes		123	135	112
Barley		34	34	31
Oats		46	47	42
Alfalfa		1 9	2.0	1.1
Mixed hay, clover and timothy		1 1	1 3	.9
Livestock income:				
Dairy products sold per cow	$	$114	$150	$77
Cattle increase per cow	$	42	40	46
Gross income from hogs per sow	$	161	173	112
Gross income from sheep per ewe	$	13	13	9
Gross income from poultry per hen	$	2 70	3.12	1.99
Man equivalent per farm		1.5	1.4	1.5
Number productive work days on crops		245	255	247
Number productive work days on stock		136	176	115
Productive work days per man		271	336	249
Crop acres per man		61	64	59
Productive animal units per man		9	12	7
Crop acres per horse without tractor		22	24	19
Crop acres per horse with tractor		33	53	29

farms $1,713, or a difference of $1,815 between the most profitable and least profitable. On the 49 farms studied, livestock comprised 60.9 per cent of the gross farm income and crops 33 per cent, the remaining 6.1 per cent was secured from miscellaneous sources such as outside labor. The livestock income was divided as follows: Dairy products and cattle increase 59.1 per cent, sheep 11.6 per cent, hogs 15.8 per cent, poultry 13.9 per cent, and horses -0.4 per cent.

The average farm expense for the 49 farms was $1,423, or $57 for every $100 of gross farm income. On the 16 higher profit farms, only $45 was expended for every $100 income, while, on the lower profit farms, $80 was expended for $100 gross income. This does not mean that there was much difference in the expenses for the two groups which were $1,585 and $1,371 respectively but the receipts on the high profit farms were large enough to make the expense per $100 of income less than on the low profit group.

This study shows that, on an average for the 49 farms, the farmer received $473 for his labor and management in 1928. This figure was determined by deducting five per cent interest on an investment of $12,101 and the allowance made for any unpaid family labor used on the farm from the farm income of $1,078. The $473, the use of the house in which the farmer lived, and the farm products used in the home constituted the operator's total labor income. A large number of farmers in this area depend on potatoes as one of the major sources of income. The low prices received for the 1928 potato crop undoubtedly makes the farm income somewhat lower than usual for this particular year.

Factors Affecting Farm Business

To operate a farm successfully, a farmer must have his organization balanced so that the land, labor, and equipment which he uses are adjusted so that each can be utilized to the fullest extent. Today, land. labor, and equipment are expensive and the only way to make them pay is to use them to the best advantage. Many farmers find it necessary to rent more land, to grow more intensive crops, to add more livestock, to improve their livestock, or to make changes in the amount of equipment they are using in order to balance their organization and make it more profitable. Others may have too much land which is either used for pasture, rented to a neighbor, or allowed to remain idle. In an attempt to balance the business, the farmer must constantly keep in mind the kind and amount of crops to grow as well as the kind and number of livestock which he can handle successfully with the labor and feed available. But it is also possible for the farmer to have a well balanced business and at the same time an unprofitable one. It may be too small or his production equipment is of inferior quality. An unproductive soil leading to low crop yields, low livestock returns, or a poor utilization of labor may keep the income down to too low a point for profitable farming.

Size of Business

Farmers having a larger volume of business usually have a larger net income, since a large share of the operating expenses tend to re-

main the same regardless of the volume of sales, consequently, the possibilities of a higher income are greater on these farms. Measures of size of farm business are presented in Table 1.

The 49 farms averaged 155 acres in size, of which 90 acres were devoted to crops. On these farms 13 productive livestock units were kept. The 16 most profitable farms had an average investment of $12,489 as compared with $12,830 for the 16 least profitable farms, the difference being in land, buildings, and machinery. The most profitable farms had approximately $800 larger investment in productive livestock.

Crop Yields

Relatively high crop yields are one of the essentials of successful farming. A study of the 16 high profit farms shows that their crop yields were much better than those on the low profit farms. On these farms, the two important cash crops, wheat and potatoes, yielded 19 and 135 bushels per acre respectively, while, on the 16 low profit farms, the wheat yield was 15 bushels and the yield of potatoes 112 bushels per acre. Thus, if the increase in yield of wheat brought $1.30 per bushel, the income per acre from wheat would be increased by $5.20 on the low profit farms. Likewise, the 23 bushels increase of potatoes at 40c per bushel would have made a difference of $9.20 per acre, or an additional farm income of $145 for the two crops. But many farmers will say, "To get better yields I must lime my soil and use more commercial fertilizer." This is true and is one of the biggest problems which the farmer in this area has to contend with. These problems are discussed fully in the Michigan Experiment Station Circular No. 77, "Fertilizer Suggestions for Kalamazoo County Soils," also, Circular Bulletin No. 60, "Lime for Kalamazoo County Soils."* Even where soil conditions are satisfactory, the better crop rotation, better seed, and better cultural methods will help to increase yields.

Livestock Returns

The livestock income from the 49 farms averaged $1,523 or 61 per cent of the total farm income. On the 16 higher profit farms, the receipts from livestock amounted to $2,309 and on the 16 lower they were but $959.

A further analysis of the table shows three more cows per farm and a greater return per cow on the higher profit farms than on the lower profit farms. The gross returns from cattle per cow from the higher group were $190 while the lower group averaged $123 or a difference of $67 per cow. The farmers in the higher group obtained a $4 greater return per ewe, $61 more per sow, and $1.13 more per hen than did those on the lower profit farms. If the 16 lower profit farms had received the same returns per animal unit as the 16 higher profit farms, they would have increased their returns from livestock by $633. If the increased amount of livestock had been kept without the higher returns per animal, they would have increased their gross income $436. A total of $1,357 or a large portion of the difference in

*These bulletins can be obtained through the Director of Experiment Station, Michigan State College, East Lansing, Michigan.

the income from these farms was due to the increased amount of livestock kept and to the greater returns per unit.

It is true that more livestock means more feed crops and perhaps more labor, but it is possible to shift the crop rotation and change farm practices so that more feed crops can be raised for a larger livestock program. Sufficient livestock also helps to utilize the farm labor to a better advantage on most farms. On an average, the farmers in this area are not keeping enough stock to keep the available labor fully employed throughout the year, especially during the winter months.

Labor Efficiency

A large proportion of the man labor performed on farms in this territory was done by the farmer and members of his family. As a whole, the man labor equivalent on the different sized farms did not vary as much as would be expected.

The high income group of farms had 89 acres of crops and 16 livestock units with a man equivalent of 1.4 while the low income group had the same number of crop acres and 11 livestock units with a man equivalent of 1.5. The low income group with the same number of crop acres and five less livestock units had approximately one month more man labor than the high group, thus showing that the high income group utilized their labor much more effectively. This is further emphasized by using standard labor requirements on crops and stock which shows the average amount of time required on these enterprises. The high group farms had sufficient crop acreage and livestock to provide for 466 productive man work days, while the low profit farms provided for 373 productive man work days. Dividing these figures by the man equivalent gives an indication of the productive work days per man. This method shows that the high profit group had 336 productive work days per man and the low profit group 249.

The important facts brought out in the above paragraph are that the higher profit group had a larger business and a better labor distribution throughout the year than the low profit group. It also indicates there was a greater efficiency in the utilization of labor on the higher profit farms because they had sufficient business to keep the labor employed throughout the year. A good labor program depends largely on a cropping system which evens up the labor requirements throughout the season and on keeping sufficient livestock to employ the surplus labor, especially in the winter. This, together with the proper field arrangement and adequate equipment, will help to distribute the labor more evenly and more efficiently throughout the year. However, labor expended on low income crops and poor livestock is poorly utilized regardless of how evenly it is distributed over the twelve months.

Horse and Mechanical Power

The horse and mechanical power on the various sized farms affords a very interesting study. The high income group of farms had 3.8 power units per farm, while the low group had 4.9 power units or 1.1 more power units than the high group.

On the high profit farms where horses supplied all the power, there were 24 crop acres per horse, and, on the low profit farms there were 19 crop acres per horse. On farms where both horses and tractors were used, there were 53 crop acres per horse on the high income farms and 29 acres per horse on the low profit farms. Thirty-eight per cent of the farmers in the high group had tractors as compared with 50 per cent in the low group.

PROBLEM OF VACCINATION AGAINST CATTLE ABORTION

National Association of Veterinarians Condemns Use of Virulent Vaccines To Control This Disease

E. T. HALLMAN, ANIMAL PATHOLOGY SECTION

The possibility of controlling cattle abortion by vaccination has been extensively studied by several Experiment Stations during the past fifteen years. Two products have been most extensively studied, a living abortus bacillus vaccine and a dead abortus bacillus bacterin. A third product, serum, has also been studied to some extent. It is the opinion of most students of this problem that neither of the two latter products possesses any value in protecting cattle against infection. It has been shown, however, that vaccination of non-pregnant cattle with living virulent vaccines has resulted in lowering the incidence of abortion in vaccinated animals. In many other respects, the results from the use of living virulent vaccine have been unsatisfactory.

1st. Such vaccination does not protect all vaccinated animals against abortion and other manifestations of infection.

2nd. The protection afforded by vaccination, in most cases, is not of long duration. Many advocates of vaccination consider it necessary to revaccinate all animals annually.

3rd. Vaccination occasionally results in the establishment of the infection in the udder. Some vaccinated animals that develop sufficient resistence to prevent abortion or disease of the fetal membrances may continue to harbor the microorganisms and disseminate them from the udder.

4th. In some cases it is difficult to get vaccinated animals with calf.

5th. Vaccinated animals react to the agglutination test for abortion disease and consequently cannot be sold as non-reactors.

6th. Certain cities prohibit the sale of raw milk from reacting cattle and 15 states have laws or regulations governing the introduction of reactors into the state.

7th. The use of living virulent vaccine in a herd from year to year perpetuates the infection in the herd as long as it is used.

8th. In the commercial production of living vaccines, it is difficult to keep the microorganism alive for extended periods of time, consequently, the microorganisms are frequently dead and, therefore, useless at the time the vaccine is used.

The fact that vaccination of cattle with living virulent vaccines often results in the establishment of the infection in the udder, together, with the publicity given during the past few years to the possible relation of abortion infection in cattle to undulant fever in man, has reacted against the use of living virulent vaccine. The report of the committee on abortion of the American Veterinary Medical Association which was accepted without a dissenting vote at the last meeting of the Association contains the following statement: "Your committee believes the distribution and use of vaccines made from living *Bacterium abortus* organisms which are virulent or which may become virulent is a dangerous procedure."

Apparently, because of the obvious harmfulness of live, virulent vaccine, certain manufacturers of abortion vaccines are advertising their product as made from non-virulent (cannot produce disease) micro-organisms. The vice-president of one of the large manufacturers of abortion vaccine, in a widely circulated article, recently made the statement that he had excellent reason to believe that every reputable producer of vaccine in this country had taken the necessary steps to make certain that the microorganisms in abortion vaccine, while highly antigenic, are non-virulent.

There are twenty or more manufacturers in the United States that have licenses to produce abortion vaccine.

During the early part of this year, Mr. J. P. Torrey of the Bacteriology section and the writer secured vaccines from nine of the larger manufacturers whose products are widely advertised and have a wide distribution, for the purpose of determining whether they were alive or dead and if alive if they were non-virulent. Since there are obvious difficulties in using cattle to determine the virulence of *Bacterium abortus,* and, since this microorganism produces a characteristitc disease in guinea pigs, the guinea pig was used to determine the virulence of these vaccines.

A detailed report of this work will be published in the Journal of the A. V. M. A. A brief discussion of the results will suffice here. Of the nine vaccines studied, our cultural data indicate that in three of them the microorganisms were dead although tests were made 20, 72, and 76 days, respectively, before the expiration dates stamped on the containers. The fourth vaccine failed to grow on culture media except for a few colonies on carbol fuchsin agar, indicating that most of the organisms were dead although there still remained a few living organisms. This vaccine was tested for growth, 99 days before the expiration date stamped on the container. The five remaining vaccines were found to consist of living microorganisms.

To determine the virulence of the microorganisms used in the vaccines, a group of eight guinea pigs was injected with each vaccine. Seventy-two guinea pigs were injected in testing the nine vaccines. These pigs were killed in from six to eight weeks after injecting and their blood and organs were carefully studied for evidence of disease

The results of examination of the eight guinea pigs receiving one of the vaccines which showed no growth on culture media and the eight guinea pigs receiving the vaccine showing no growth except for a few colonies on carbol fuchsin agar indicate that each of these two vaccines still contained a few living abortus bacilli that were virulent for guinea pigs.

No lesions were found in the two groups of pigs receiving the other two vaccines which produced no growth on culture media.

Of the five remaining vaccines, three showed as much virulence for guinea pigs as many recently isolated strains of abortion bacilli from aborting cattle.

One of the remaining two produced no distinct lesions in any of the eight pigs receiving it. However the abortus bacillus was recovered from three of the eight pigs at the time of autopsy and these cultures reinjected into a group of nine guinea pigs produced lesions in five of the pigs as extensive as those produced by many recently isolated strains from aborting cattle. Thus, when the microorganisms of this vaccine were given a favorable environment they showed the ability to produce extensive lesions.

One of the eight guinea pigs receiving the last vaccine to be discussed died a few days after injection. Of the seven, killed six to eight weeks later, three showed positive evidence of virulence and three others showed suspicious evidence of virulence.

While we have no definite information of the twelve or more commercial vaccines not tested by us, our work demonstrated .hat the nine widely advertised vaccines that were tested consisted of either dead or virulent microorganisms.

These results indicate that the breeder who resorts to vaccination with any of the products we tested as a means of controlling infectious abortion takes about 45 chances out of 100 of using a product that is considered worthless by a majority of the students of the abortion problem and about 55 chances out of 100 of using a product that will perpetuate a condition in his herd, as long as he continues to use it, that places restriction on the sale of his cattle in 15 States, at this writing, and excludes the sale of raw milk in a rapidly increasing number of cities.

MULCHING STRAWBERRIES PAID WELL AT COLLEGE

R. E. LOREE, HORTICULTURAL SECTION

The application of a winter mulch on strawberry fields is often neglected. In many cases, this is due to a scarcity of suitable mulching material, which the grower hesitates to purchase on account of the extra expense. However, the results obtained from mulching experiments at East Lansing show that the cost of the mulch and its application is more than compensated by larger yields and better fruit.

In the particular experiment on which this is a report, plants of the Gibson variety were grown in narrow matted rows during the season of 1926. The mulch was applied on three 1/20 acre plots in late November and was allowed to remain until after the close of the harvesting season in 1927. In the spring, the mulch, which was three or four inches in thickness, was opened over the rows to allow the plants to grow through and the excess mulch was pushed into the alleys between the rows.

The average yield from the three mulched plots for the year 1927 was at the rate of 2,988 quarts per acre and from three unmulched plots 2,275 quarts per acre. This is a difference of 716 quarts or nearly 45 16-quart crates per acre in favor of the mulched plots. On the basis of the average price received, $2.00 per crate, for berries at East Lansing, this amounts to an added gross income of $90.00 per acre which is considerably more than the cost of the mulch. Furthermore, the berries were cleaner, brighter, and generally of a higher grade than those from the unmulched plots.

The chief benefits derived from the mulch in this experiment appeared to be to keep the fruit clean, to conserve moisture, and to smother weeds during the harvesting season. Apparently, there was no serious injury to the plants during the winter of 1926-27. Had there been considerable winter injury the difference in yield between the mulched and unmulched plots undoubtedly would have been larger. In 1928, there was more rain during the harvesting season and the differences in yield were not as large as those in 1927.

Though the evidence from the results of this experiment does not prove conclusively that winter protection of the Michigan strawberry plantation is absolutely essential, it is indicative of the benefits and the profits which may accrue to the grower from the use of a mulch. A mulch is particularly valuable in localities where there is not enough snow to afford ample winter protection and where the rainfall is likely to be light during the harvesting season.

HARDY ALFALFAS LEAD MICHIGAN OVER-STATE TESTS

Hardigan and Grimm Are Varieties Best Adapted to This State

H. C. RATHER AND G. F. WENNER, FARM CROPS SECTION

Michigan farmers have made great strides in alfalfa growing during the past ten years and much of their success in maintaining profitable alfalfa stands has been due to the use of seed of the more hardy varieties.

Previous work* at the Agricultural Experiment Station of the Michigan State College at East Lansing has tended to group alfalfa varieties into three classes. The first class includes the Hardigan, Grimm, Cossack, and Ontario Variegated strains, all of which are very well adapted to Michigan and will yield exceedingly well if growing conditions are at all satisfactory. The second group is comprised of a number of common strains of alfalfa from northern and western states, which give fair results in Michigan but which lack the hardiness and longevity of Grimm and Hardigan. In the third group are Hairy Peruvian and seed from Arizona, South America, and South Africa, a class of seed totally lacking in winter hardiness and not at all suited for growing in Michigan.

For several years, tests similar to those on the Experiment Station farm at East Lansing have been conducted in cooperation with individual farmers in various parts of the state, under soil and climatic conditions somewhat different from those at East Lansing. Despite such differences, these over-state tests have practically duplicated the results secured at East Lansing, and they give added emphasis to the need for planting hardy kinds of alfalfa seed in every part of Michigan.

Occasionally, farmers question whether or not common alfalfa might not be more satisfactory than the variegated types on sandy soil. The supposi-

*Hardy Alfalfa Varieties Needed in Michigan, Cox and Megee, Michigan Quarterly Bulletin, Vol. X, No. 3.

tion is that its root system will go deeper after moisture than the more branching roots of the variegated alfalfas. There is no apparent foundation for such a contention, for, when planted under identical conditions, the roots of Hardigan or Grimm alfalfa go just as deep for moisture as the roots of any of the common types, even though the former do have heavier lateral branches. Certainly, the Grimm, Cossack, and Hardigan proved the more productive on light, sandy land in Alpena county (see Test A) where both low fertility and lack of moisture tended to keep all yields low. In the Alpena county test, Kansas Common, Utah Common, and Argentine alfalfas were entirely killed out during the second winter; South Dakota and Michigan Common came through without serious injury; while Hardigan, Cossack, and Grimm suffered no appreciable winter injury, their low yields being due to poor growing conditions, rathe than to a lack of stand.

Field of Hardigan Alfalfa on Sand Land in Northern Michigan.

Though Hardigan alfalfa has not always led in the variety tests during the first year, it has worked its way to the top of every one of the tests harvested for a period of two, three, or more years. In Test D, in Livingston county, the yield of Hardigan was exceeded by that of several varieties in 1924, yet by 1927 its yield was right at the top. In most tests, this very desirable variety has been at or very near the top right from the first harvest. As seed becomes more and more plentiful, Hardigan alfalfa surely deserves to find a place as Michigan's most widely grown variety.

The Grimm-Common question is answered very much in favor of Grimm in every instance. Even for short rotations, Grimm alfalfa is undoubtedly better than common alfalfa, under a wide range of Michigan conditions. Utah Common, for example, has been considerably below Grimm even the first season in every case save one (see Test D.). In the Brighton test, it started ahead of both Grimm and Hardigan but finished next to Turkestan at the bottom of the test. Utah Common has not been as good in any of the over-state tests as common alfalfa from Michigan, South Dakota, or Kansas.

In the East Lansing trials, it has been about on a par with Idaho Common and a little below the average run of common alfalfa from Montana.*

As has been demonstrated repeatedly, alfalfa seed from Turkestan and the Argentine is not satisfactory for Michigan. Since these strains must be stained 10 per cent red and 10 per cent orange-red, respectively, before they are permitted entry into this country, farmers can avoid them by refusing to buy alfalfa seed stained in this manner.

Map Showing Location Of Over-State Alfalfa Variety Tests

Arizona Common, even less desirable than Argentine or Turkestan seed, cannot be avoided so easily. The farmers' one protection against Arizona seed is to buy from dealers of established reliability seed of known origin coming from localities which produce alfalfa of demonstrated hardiness as indicated by these tests. The most dependable alfalfa seed is that of varieties such as Hardigan, Grimm, and Cossack certified by the Crop Improve-

*Hardy Alfalfa Varieties Needed in Michigan—Cox and Megee, Michigan Quarterly Bulletin, Vol. X, No. 3.

ment Associations or Seed Certification Services of the States in which it is grown and coming to the Michigan grower in officially sealed containers.

Since all of these tests are some distance from East Lansing, comparative yield records have been secured by taking the yield of only the first cutting each season. The following tables give the yield of seven over-state alfalfa tests harvested for two or more seasons. Several additional tests in other locations were planted in 1928 and 1929 and the results from these tests will be reported after two or three years' records have been secured.

Yield Records on Over-state Alfalfa Variety Tests*

TEST A

Cooperator	Charles Reuhl, Cathro
County	Alpena
Year Planted	1923
Soil	Sand

Variety	Yield of first cutting in tons of air dry hay per acre			
	1924	1925	1926	1927
†Hardigan (Michigan)	1.52	80	25	88
Cossack	1 55	77	25	.76
Grimm (Michigan)	1 35	75	23	75
Le Beau (Michigan)	1 29	53	33	.63
Common (South Dakota)	1 12	37	21	.62
Turkestan	1.14	53	12	39
Common (Kansas)	1 20	00	00	00
Common (Utah)	94	00	00	00
Argentine	.71	00	00	00

TEST B

Cooperator	Ed. Donahue, Sterling
County	Arenac
Year planted	1927
Soil	Sandy loam

Variety	Yield of first cutting in tons of air dry hay per acre	
	1928	1929
Hardigan (Michigan)	1.64	3 54
Grimm (Michigan)	1 70	2 64
Ontario Variegated	1 43	2 62
Common (Michigan)	1.50	2 44
Argentine	.47	00
Arizona Common	00	00

*The data from these tests were secured by D. F. Rainey and H. C. Kiebler, former members of the Farm Crops Section, R. H. Morrish, now Extension Specialist in Farm Crops at the Michigan State College, and G. F. Wenner, now Research Assistant and Extension Specialist in Farm Crops.

†In each instance, varieties are arranged in order of their yield during the last season that yield records were taken.

TEST C

Cooperator . . . . . . George Black
County. . . . Sanilac
Year planted 1924
Soil . . . . Clay

Variety	(1) Yield of first cutting in tons of air dry hay per acre	
	1925	1927
Hardigan (Michigan)	3 12	2.24
Cossack	3 00	2.03
Grimm (Michigan)	2 90	1 99
Liscomb	2 93	1.66
Common (Michigan)	2.70	1 72
Common (South Dakota)	2 63	1 56
Common (Utah)	2 51	1 23
Turkestan	2 83	.63
Argentine	1.92	.69

(1) Yield records taken in 1925 and 1927 only. Plowed up in 1928.

TEST D

Cooperator . . . F. E Meyer, Brighton
County. . . Livingston
Year planted . . . 1923
Soil . . . Clay loam

Variety	(1) Yield of first cutting in tons per acre of air dry hay	
	1924	1927
Hardigan (Michigan)	1 20	1 80
Cossack	1 24	1 78
Common (Michigan)	1 47	1 74
Common (South Dakota)	1 35	1 72
Grimm (Michigan)	1 34	1 61
Common (Kansas)	1 63	1 51
Common (Utah)	1 45	1 30
Turkestan	.93	1 21

(1) Yield records taken in 1924 and 1927 only. Plowed up in 1928.

TEST E

Cooperator . . . . H. O Wasson, Gregory
County. . . . . Livingston
Year planted. 1924
Soil. . . . . Sandy loam

Variety	Yield of first cutting in tons of air dry hay per acre				
	1925	1926	1927	1928	1929
Hardigan (Michigan)	1 00	1 42	3 04	2 78	2 11
Cossack	.96	1.38	2 92	2 63	1.94
Liscomb	.80	1 30	2.77	2 48	1.92
Grimm (Michigan)	.91	1.22	2.99	2 29	1 74
Common (Michigan)	91	1 34	2.80	2.33	1.74
Common (South Dakota)	.65	1 16	2 63	2.25	1.60
Common (Utah)	.69	1.25	2.38	1.21	1.23
Argentine	.68	1.11	1.92	.19	.40

TEST F

Cooperator . . . . O. R. Kintigh, Mosherville
County . . . . Jackson
Year planted 1924
Soil . . . . Sandy loam

Variety	Yield of first cutting in tons of air dry hay per acre				
	1925	1926	1927	1928	1929
Hardigan (Michigan)	.95	1.48	3.40	1.91	2.34
Cossack	1 05	1 37	2.92	1.73	2.32
Grimm (Michigan)	.95	1 39	3.00	1.71	2.12
Liscomb	.73	1 38	2.60	1.20	1.82
Common (South Dakota)	. . .	1 36	2.93	1.57	1.61
Common (Michigan)	1.02	1.56	2 29	1.43	1.58
Common (Utah)	.76	.68	1 95	1 43	1 42
Turkestan	65	1.00	2 14	1.40	1.04
Argentine	.45	.72	.97	.69	.73

TEST G

Cooperator . . . . D. T. Bascom, Montgomery
County . . . . Branch
Year planted 1925
Soil . . . . Sandy loam

Variety	Yield of first cutting in tons of air dry hay per acre		
	1927	1928	1929
Hardigan (Michigan)	3 35	2 56	2 35
Grimm (Michigan)	3 37	2 01	2.11
Le Beau (Michigan)	3 39	1 78	1 71
Common (Utah)	2 69	1 51	1 63
Argentine	1 92	1 46	1.48

ERRORS IN METHODS CAUSE FAULTY GRAFT UNIONS

Study Shows Suspected Uncongeniality of Varieties Is Not Reason For Most Failures of Cion and Stock to Unite

BY F. C. BRADFORD, HORTICULTURAL SECTION

The occasional occurrence of unsatisfactory graft unions in top-worked pear and apple trees has sometimes been interpreted as a manifestation of uncongeniality between certain varieties. In Michigan, the question has been raised most frequently concerning Kieffer pear as a stock for other varieties, but some combinations in apple have come under suspicion. Further search reveals perfectly good unions with these same combinations, thus disposing of the possibility of inherent uncongeniality, but leaving the poor unions unexplained.

Some of these poor unions have been studied rather minutely and a de-

tailed report on them has been published as Technical Bulletin 99 of the Michigan Agricultural Experiment Station. In this study, certain admittedly uncongenial combinations, pear on apple, and Bartlett pear on quince, were considered and uncongeniality was found to be expressed in continued breaking of cambium at the union between stock and cion. For a short period, contact is re-established and broken several times, but, ultimately, the connection becomes poorer and continued growth of stock and

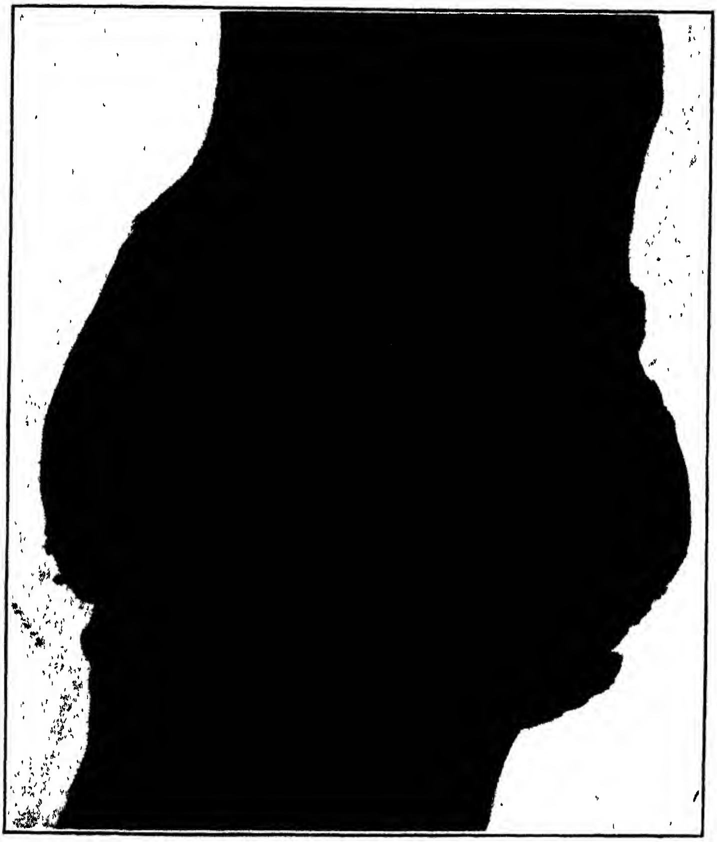

Fig. 1. (Fig. 1) Rhode Island Greening on Duchess apple. Swellings such as this at the graft union have been considered to indicate varietal uncongeniality. Microscope examination shows that the union was perfectly congenial, but tilting of cions had set up disturbance extensive enough to produce the swelling, delay healing, and make a weak union.

cion leaves bark inclusions between the two. Generally this process results in the death of the tree or in breaking off of the top.

The suspected unions, various varieties of pear on Kieffer, and Rhode Island Greening apple on Duchess apple, showed large swellings and failure to heal the stub, but microscopic examination revealed no evidence of cambium and phloem breaks such as characterized the truly uncongenial unions. This finding, combined with field observation of good unions with these

same combinations, indicated that the trouble originated, not from uncongeniality, but from some fault in the manner of making the graft.

All of the numerous bad unions which were examined possessed one character in common, namely, the cions had been tilted outward in the manner formerly much advocated to ensure cambium contact between stock and cion. It seems quite likely that slight tilting does not lead to trouble, but the margin of safety is easily passed. The effect of this tilting is compara-

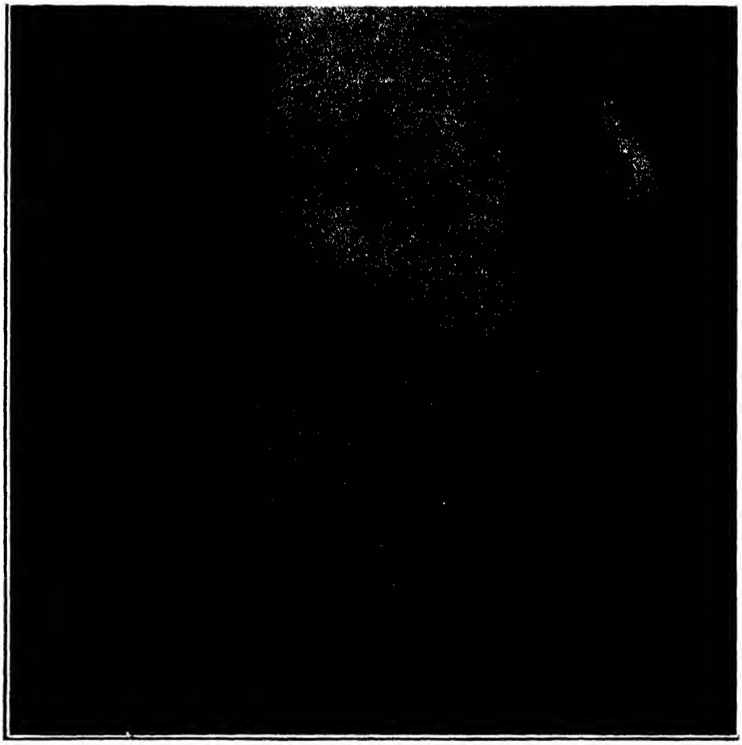

Fig. 2. (Fig. 82) Same as Fig. 1, but from different angle and with bark removed. This shows dieback at rim of stub, downward pointing of tissue on stub and piling up of tissue resulting in cavity where wood should be solid. As the cion and stub expand the resultant pressure may cause breaking out of the cion. With proper setting of cion (right angle to stub) and contact at top, the tissue of the stub flows over the rim directly toward the cion, covers the wound rapidly, and makes a strong union.

ble to that of cutting a fairly large branch back to a very small lateral, and leaving a projecting stub. The wood grain always reorients itself with reference to the highest point of contact between cion and stock. With cions properly set, this point is at the very top of the stub; with tilted cions it is well below the rim. The tissue of the stub above the contact point either dies or reorients itself pointing downward to the cion. In either case, healing over the top of the stub is greatly retarded and a swelling develops at the union. As the cion expands, this downward pointing tissue exerts pres-

sure against the cion without uniting directly with it, and the cion may even break out, presenting to ordinary examination the appearance of uncongeniality.

This statement of conditions is not to be construed as a sweeping denial of the possibility of uncongeniality existing between certain varieties, but it does indicate that varietal uncongeniality is not likely to be encountered in Michigan orchards. Faulty unions are generally due to failure to set cions in correct alignment. Some varieties, when used as stocks, may have less capacity of readjustment to unfavorable conditions than other varities, but, with correct vertical setting of cions, all varieties examined are capable of making good unions.

MATURITY INFLUENCES QUALITY OF ALFALFA SEED

Percentages of Germination of Immature and Frozen Seed Determined

M. S GRUNDER AND C. R. MEGEE, FARM CROPS SECTION

The second cutting of alfalfa frequently does not mature a seed crop before danger of fall frosts and adverse weather conditions appear. The following experiment was conducted to assist in answering the question as to whether the half-grown crop of alfalfa seed in the late fall is worth harvesting. The influence of a freeze upon the standing seed crop was also tested in the experiment.

A large number of alfalfa pods, in all stages of maturity, ranging from very immature to ripe, brown pods, were collected during the fall of 1927. Immediately after picking, the pods were sorted into the following seven classes:

A. Very immature.
B. Beginning to fill.
C. Becoming plump.
D. Plump green.
E. Light brown mature.
F. Medium brown mature.
G. Dark Brown mature.

After heavy freeznig occurred three more classes were obtained, as follows:

AA. Immature—frozen.
BB. Plump green—frozen.
CC. Mature—frozen.

Each of the above 10 classes consisted of 1,000 pods. The pods were later threshed and determinations made of the seeds from each class for number, the percentage of plump seed and of germination. The following table shows some of the data obtained.

Characteristics of alfalfa seed harvested at different stages of maturity and under different conditions during Fall of 1927

Each class consisted of 1,000 pods.

Class	Condition of Pod	Total No. of Plump Seed	Per cent of Plump Seed	Germ. of Plump Seed %	Germ. of Brown Seed %	Germ. of Small Seed %
A.	Very Immature	95	11 2	98 7	2.7	10 3
B.	Beginning to fill	625	27 1	96 7	8.4	32.1
C.	Becoming Plump	2752	64 8	96 2	20.0	72.6
D	Plump Green	4282	72.6	98 5	31 6	83.6
E	Light Brown Mature	2744	64.5	96 6	21.3	64 5
F	Medium Brown Mature	3270	69 3	98 1	23 1	84.2
G.	Dark Brown Mature	4359	77.7	97 9	22.9	89.9
AA.	Immature Frozen	106	4 6	100 00	30 1	50.0
BB.	Plump Green Frozen	322	6 6	100 00	45 0	84.3
CC	Mature Frozen	2845	58 2	99 1	37 5	88.1

The seeds from the dark brown pods were heavier and more numerous than from any other class. It was also found that the small seeds in this class were heavier and showed a higher germination than the small seed from any other class, the germination being approximately 90 per cent.

The results showed that seeds which had reached slightly less than one-half full weight, could be expected to have a germination of at least 70 per cent, the germination rising as the average weight increased.

Brown seeds were shown to have little value except in the case of pods frozen in the more advanced stages of maturity. In this condition brown frozen seeds had a germinating power of 30 to 40 per cent. Bright plump seed from pods frozen in the more advanced stages of maturity showed a very high germination, the weaker seeds evidently being discolored by freezing.

This test indicates that if weather or other conditions demand it, the alfalfa seed crop can be cut when the seeds are one-half or more grown, though the majority of the pods are still green. By screening out the seeds less than one-half grown and by fanning out the brown seeds, which are usually light in weight, a seed of fair quality may be secured.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

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71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
80 Yellow Rocket (a dangerous weed).
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
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98 Vinegar.
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110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
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124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
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181 A Study of Town-Country Relationships.
182 Strawberry Growing in Michigan.
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184 Size of Peaches and Size of Crop.

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†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

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121 Distribution of Acid Soils, Kent County.
122 Distribution of Acid Soils, Tuscola County.
123 Farm Milk Houses.
124 The Young Vineyard.
125 The Mint Flea Beetle.
126 Essentials of a Mulch Paper Laying Machine.
127 Pruning Young Fruit Trees.

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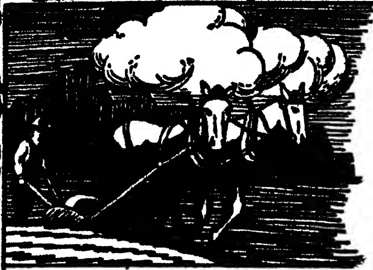

THE

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MICHIGAN STATE COLLEGE
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East Lansing, Michigan

VOL. XII FEBRUARY, 1930 NO. 3

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CONTENTS

EDITED BY

V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XII, No. 3, February, 1930

BLACK ROOT OF STRAWBERRY RUINS PLANTATIONS

Wilting of Plants Caused by Disease Which Is Common in Michigan

F. C. STRONG AND M. C. STRONG, BOTANICAL SECTION

Among the cultivated crops, the strawberry has long been considered as one in which the disease hazard for the grower is small. Mildews, leaf spot, and a few fruit rots have attracted the attention of the growers at times, but these diseases are usually of minor importance and no special control measures are practiced.

There is, however, a situation in strawberry culture which is a subject of concern to the grower. This is the failure of newly set plants to become established, and the dying of plants, which in severe cases, may involve considerable areas in a plantation.

It has been known for a long time that strawberry plantations can rarely be kept at a high rate of productivity for more than two years. The standard practice in strawberry growing is to plant in the spring or late summer. The first crop is harvested the following spring. Runners from these plants are then allowed to strike root between the original rows which are later plowed up. The third year the stand is usually poor, and the plantation is on the down grade in production. The problem is not one of soil fertility. The strawberry seemingly does well on soils of low fertility, and many plantations on rich soil show poorer stands than those on light soils.

Black Root, a Parasitic Disease

Drouth injury and winter killing have been considered as the more important factors in the decline of strawberry plantations. However, experiments begun in 1923 and extending over a period of four years, have shown that there is a parasitic disease of strawberry roots, known as black root, which is capable of being transmitted from diseased roots to healthy ones.

Description of the Black Root Disease

The appearance of a strawberry plant affected with black root is typical. The diseased plant shows poor vitality, is characteristically stunted, and has a tendency to dry up during periods of dry weather. The leaves may wilt down during the day and recover at night. If dry weather continues, however, the plants will dry up with berries in varied stages of growth, hanging on the stem, the leaves may become purplish or bronzed, and the petioles will turn red. Such a plant, on being dug up, will show a root system which is black, corky in texture, and apparently dead.

The examination of a younger plant which is affected with black root gives a better picture of the disease. Young plants are stunted, and have small leaves and few roots. Some of the main roots of such a plant will be rotted the entire length, and many brown or black lesions will be found. These lesions may vary in size from one-half inch to two inches in length, and may encircle the root. The color of the lesion is usually reddish brown at first and later becomes black. In early stages, lesions exhibit a water-soaked appearance, but soon become shriveled and shrunken. Very often, the root is entirely rotted off.

Lesions on lateral roots resemble those on the main roots. It is probable that the attack upon the lateral roots is very important in producing the

Fig. 1. Wilting of plant in field due to black root disease.

general effects of black root since most of the root hairs through which water and plant food materials enter the plant are on those portions of the root system. This reduction in the efficiency of the root system in obtaining water for the plant results in the characteristic wilting. The reduction in the available supply of food materials weakens the plant and makes it susceptible to drouth injury and winter killing.

Distribution of the Disease

Black root of strawberry is widely distributed not only in Michigan but throughout the United States and Canada. What appears to be a similar disease has also been reported from Scotland and Africa. The widespread distribution of the disease and the fact that wild strawberry plants are often affected indicate that the cause is to be found among the naturally occurring soil organisms.

The Causal Organism

Three common soil fungi were repeatedly isolated from diseased strawberry roots, a Fusarium, a Coniothyrium, and a Patellina. Many inoculation experiments both with clean seedlings and clean runner plants showed that

Fig. 2. Comparison between healthy plant (right) and diseased plant (left). Infection due to inoculation with pure culture of Patellina sp.

the Coniothyrium and Patellina species were able to produce the black root disease. Investigators in other parts of the country have found that species of Fusarium and Pythium are also associated with this disease. It is probable that many soil fungi are able to infect strawberry roots, weaken the plant, and make it susceptible to drouth injury and winter killing.

Control Measures

It is evident that black root of strawberry may be spread by diseased plants being sent out from the nurseries, but, due to the wide-spread distribution of the casual fungi in the soil, it is equally probable that young plants may

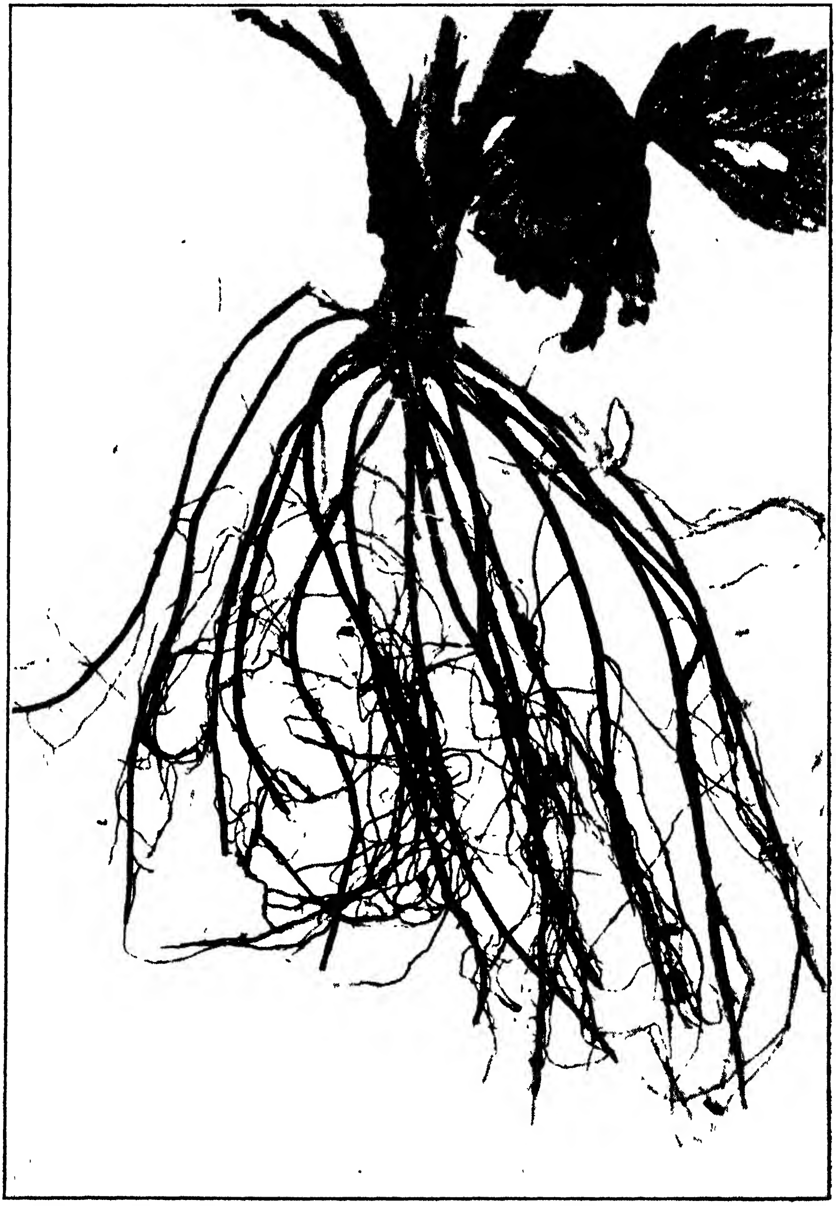


Fig. 3. Badly diseased root system of an older plant infected with black root (natural infection).

become infected when they are set in the new plantation. The handling of plants during transplanting injures many roots and aids in the invasion of the roots by these fungi which are present in the soil. During the course of the investigations, many attempts were made to control this disease by dipping the young plants as they came from the nursery and before they were set, in various disinfectant solutions of formaldehyde and mercury. None of these treatments was effective in controlling the disease. Attempts at sterilization of the soil by chemicals were likewise unsuccessful.

The only control measures which can be recommended are:

1st. The selection of strong, vigorous plants which have clean white roots.
2nd. The careful and rapid handling of the plants in setting so that they may be subjected to as little drying out and mechanical injury as possible.

The practice of setting out a plantation in the spring, harvesting a crop the following year, and plowing up the plantation is to be recommended. This permits of a rotation of crops which is desirable. A strawberry plant seems to have remarkable ability to form new roots. Keeping the plant in a vigorous state of growth by cultivation and application of suitable fertilizers will help the plant to form new roots as the old ones rot off, and will aid the plant in outgrowing the infection. The ultimate control will perhaps depend on the development of resistant varieties.

NEED MINERAL SOIL FOR SPRUCE AND BALSAM SEEDLINGS

Natural Reproduction Can Be Obtained on Grassy Areas Within or Near Forests by Plowing Furrows

PUTNAM W. ROBBINS, FORESTRY SECTION

There are few second growth spruce and balsam forests in Michigan which are fully stocked throughout their entire area. They usually contain some brushy, grass covered areas of a quarter acre or more in size. These openings are the results of previous operations which were followed by fire or are old camp, skidway and landing sites, or small clearings made for agricultural crops. They are generally covered with litter, sod, raspberry bushes, and hazel brush which create adverse conditions for the establishment of natural reproduction.

Spruce or balsam seed which falls upon sod or litter may germinate and grow during the spring when the grass and litter contain sufficient moisture for germination, but the seedlings die during the summer when the development of the grass takes the available moisture. Seed which germinates upon litter usually dies when the litter dries out during the summer because spruce

and balsam seedlings are shallow rooted and seldom get their roots down into the mineral soil before the beginning of the dry summer weather. Seed which falls beneath raspberry or hazelbrush must compete with the bushes, and these seedlings generally die during the summer for lack of light and moisture.

Reproduction is established very slowly on areas where such adverse site conditions are present. When natural reproduction does take possession of the site it is usually aspen, paper birch, or other weed trees which do not produce saleable timber. Shallow rooted species like spruce and balsam make their best growth and are more likely to survive when they germinate upon mineral soil.

Planting Sometimes Necessary

Barren areas within or adjacent to a spruce or balsam forest should be replanted or put in condition to permit natural reproduction throughout the entire forest area. In planting spruce and balsam forests, which are maintained for pulpwood, it is best to use white spruce because it makes the finest paper pulp and brings the highest market price. Planting such areas is not often practicable, however, because of the lack of proper seedlings or the cost of the undertaking. Therefore, some means of natural reproduction must be relied upon to restock the areas.

In order to determine if nature could be aided in establishing natural reproduction on brushy, sod covered areas within spruce and balsam forests, a sample plot was laid out at the Dunbar Forest Experiment Station in August, 1928. This plot consisted of an area of one-fourth acre upon which all large weed trees were removed for fuel and the mineral soil exposed by plowing irregular furrows approximately six feet apart over the entire area. Large weed trees on such areas which are not valuable for fuel should be girdled. The plot was surrounded by 17 white spruce trees, 7 balsam fir, 1 white pine, and 2 tamarack which bore a good crop of cones at the time the plot was established.

One year later, in August, 1929, the plot was examined and all seedlings in the furrows and on the turned sod were counted. In order to furnish a check on the original condition the seedlings were also counted on a strip of sod one foot wide adjacent to the furrows, and it was assumed that the number of seedlings on this strip furnished an average of what would have occurred on the entire area if no furrow had been run.

The examination showed that the mineral soil in the furrows contained 2,994 white spruce and 211 balsam fir seedlings.

The mineral soil of the turned furrows contained 774 white spruce and 80 balsam fir seedlings.

The count made on the strip of sod adjacent to the furrows showed that there would have been 268 spruce and 48 balsam fir seedlings on the quarter acre if no furrows had been run.

Increase Secured by Plowing

In this experiment, aiding nature by exposing the mineral soil in furrows approximately six feet apart on a sodded, brushy area increased the number of seedlings by over 12 times the number which would have been present under natural conditions. Experience has shown that seedlings which germinate on sod are less likely to survive than those which come in on

mineral soil. There are few young trees found on sodded areas of this type. Comparatively few seedlings which come up even on the exposed soil are likely to survive the competition for moisture with the encroaching grass and brush. However, if only 10 per cent survive and live to advanced reproduction size, the area will be fully stocked.

This experiment is not extensive enough to prove conclusively that natural reproduction can always be secured by aiding nature in exposing the mineral soil on barren areas, but it gives an index of results which may be expected.

RUSSIAN CLOVER SEED IS QUESTIONABLE

Domestic Strains Prove Superior in Trials of Hay and Seed Producing Values

C. R. MEGEE, FARM CROPS SECTION

During the past three years, strains of clover from many of the seed producing centers outside of the United States have been tested at East Lansing. None of the imported strains have proven as dependable over a period of years as have our own domestic grown strains. Some of the imported lots have shown up fairly well for a year or so but have not been able to maintain as consistently high yield as the domestic grown lots.

Until recently, imports from Russia have received but little attention due to the small amount of seed offered. In 1927 and again in 1928, several Russian lots of seed secured through the Bureau of Plant Industry, U. S. Department of Agriculture, were planted at East Lansing in comparison with a number of domestic or home grown lots.

Little difference was noted between the Russian and domestic lots of seed in winter hardiness. Both kinds came through the winters of 1927-28 and 1928-29 with excellent stands. The Russian lots may be divided into two groups determined by the number of cuttings secured. Many of the Russian strains were designated as single cut because they produced only one cutting of hay. Owing to the fact that these strains produced practically no bloom, it has been impossible to harvest a seed crop. If the farmers of Michigan are interested in growing a single cut, or one crop clover, it would be far better for them to use our own Mammoth or Bull clover, which produces both hay and seed in far greater quantities than do the Russian strains.

A few of the Russian strains produced two crops in one season. The first crop was fair in yield, but the second was exceedingly light in yield of hay and of little or no value for seed. When a double cut, or two crop clover, is desired, far better yields of both hay and seed will be secured from our own domestic strains of June clover.

Furthermore, the market does not differentiate between the seed ot single cut and double cut Russian Strains. This in itself is sufficient to justify the use of home grown clover seed.

FATTENING RATIONS FOR WESTERN LAMBS TESTED

Trials Show Variations in Worth of Various Grain Mixtures

BY G. A. BROWN AND G. A BRANAMAN, ANIMAL HUSBANDRY SECTION

One hundred fifteen western feeding lambs which averaged 61 pounds in weight were purchased on the Chicago market September 24, 1929, at $13.00 per hundredweight at Chicago. These lambs were fed on clover hay until October 4 when the first of the three initial weights were taken and the lambs were divided into seven lots of fifteen lambs each. The lots were as near equal as it was possible to make them from the standpoint of weight, form, condition, quality, sex, and feeding capacity. Eight large coarse lambs, one small lamb, and one lamb which was out of condition were not used in the experiment.

The object of this test was to study the comparative feeding values of:

A. Corn versus barley. Lots 2 and 6.
B. Corn versus oats. Lots 2 and 7.
C. Barley versus oats. Lots 6 and 7.
D. Alfalfa hay versus silage and alfalfa. Lots 1 and 2.
E. Linseed meal versus no protein supplement. Lots 2 and 3.
F. Oats with and without a protein supplement. Lots 4 and 7.
G. Amount of protein supplement to feed with oats. Lots 4 and 5.

The rations which were fed were:

Lot 1. Alfalfa hay, shelled corn
Lot 2. Alfalfa hay, shelled corn, silage.
Lot 3. Alfalfa hay, shelled corn 7 parts, linseed meal 1 part, silage.
Lot 4. Alfalfa hay, oats 7 parts, linseed meal 1 part, silage.
Lot 5. Alfalfa hay, oats 14 parts, linseed meal 1 part, silage.
Lot 6. Alfalfa hay, barley, silage.
Lot 7. Alfalfa hay, oats, silage.

Second cutting alfalfa hay of good quality was fed throughout the test. At the beginning of the test, each lot, of 15 lambs, was receiving 6 pounds of grain, 6 pounds of silage and 30 pounds of hay daily except lot 1 which did not receive silage. The grain allowance for all lots was increased to one pound per head daily by the end of the second week, and to one and one-third pounds per head daily by the end of the fifth week. Lots 1 and 2 would not consume more than one and one-half pounds of grain per head daily at any time without going off feed. Lots 3 to 7 inclusive received one and two-thirds pounds of grain per head daily during the last 30 days. Owing to weather conditions during the growing season, the silage was immature and contained but little corn. Five weeks elapsed before the lambs were eating the

maximum amount fed which was one and one-third pounds per head daily. The amount of hay was reduced as the silage and grain allowances were increased.

When on full feed, the daily rations for each lot were approximately as follows:

Lot 1.	22 lbs. corn	26 lbs. hay	
Lot 2.	22 lbs. corn	18 lbs. hay	20 lbs. silage
Lot 3.	26 lbs. grain	16 lbs. hay	20 lbs. silage
Lot 4.	26 lbs. grain	14 lbs. hay	20 lbs. silage
Lot 5.	26 lbs. grain	14 lbs. hay	20 lbs. silage
Lot 6.	26 lbs. grain	16 lbs hay	20 lbs. silage
Lot 7.	26 lbs. grain	16 lbs. hay	20 lbs. silage

When the lambs were on full feed it was necessary to reduce the hay and silage allowance during periods of warm muggy weather.

SUMMARY OF RESULTS

15 Lambs per Lot –90 Days—October 5, 1929—January 3, 1930

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
	Corn, alfalfa	Corn, alfalfa, silage	Corn, 7 parts alfalfa, silage, linseed meal 1 part	Oats 7 parts, linseed meal 1 part, alfalfa, silage	Oats 11 parts, linseed meal 1 part, alfalfa, silage	Barley, alfalfa, silage	Oats, alfalfa, silage
No of lambs	15	15	15	15	15	15	15
Av initial wt	62 2	62 3	62 4	62 7	62 7	62	62 3
Av final wt	96	96 2	97 3	94 2	93 3	91 8	90 3
Av gain per lamb	33 8	33 9	34 9	31 5	30 6	29 8	28
Av daily gain	375	376	388	35	340	331	311
Av daily ration:							
Shelled corn	1 135	1 17	1 103				
Linseed meal			1571	157	081		
Alfalfa	1 88	1 44	1 42	1 39	1 39	1 42	1 42
Corn silage		1 012	1 028	1 067	1 067	1 067	1 058
Oats				1 10	1 178		1 26
Barley						1 26	
Feed per 100 lbs gain.							
Shelled corn	303 06	311 00	281 16				
Linseed meal			40 55	45 12	24 72		
Alfalfa hay	501 58	383 00	365 83	308	409 36	429 82	455
Corn silage		269	264 88	305 29	314	323	339 42
Oats				315 99	346 62		404 86
Barley						382 17	
*Feed cost per 100 lbs gain	$8 31	$8 41	$8 94	$9 02	$9 09	$10 07	$10 66
Initial cost per cwt. in 1 lots	13 25	13 25	13 25	13 25	13 25	13 25	13 25
Initial cost per lamb in lots.	8 24	8 25	8 27	8 31	8 31	8 21	8 25
Feed cost per lamb	2 80	2 85	3 12	3 12	3 05	2 99	2 99
Cost of lamb plus feed cost	11 04	11 10	11 39	11 43	11 36	11 20	11 24
Necessary selling price in lots	11 50	11 54	11 70	12 13	12 17	12 20	12 45
†Selling price in lots	12 95	12 95	12 95	12 95	12 95	12 95	12 95
Selling price per head	12 43	12 46	12 60	12 20	12 08	11 89	11 69
Returns per lamb above feed cost	1 39	1 36	1 21	77	72	69	45

*Prices of feeds: All grain $1 75 per cwt (corn 98c per bu , barley 84c, oats 56c) alfalfa hay $12 per ton. Linseed meal $55 00 per ton.

†Selling price in Detroit $14 00, less expense and shrink $1.05 per hundred pounds.

Conclusions

1. In this trial, lambs which were fed corn with silage and alfalfa gained more rapidly, required less feed per unit of gain and gave a return above feed costs nearly double that returned by lambs which were fed barley and a return three times as great as the return made by lambs which were fed oats. Lots 2, 4, and 7.
2. Lambs on barley gained more rapidly and showed a greater return per lamb above feed costs than did lambs on oats. Lots 6 and 7.
3. The addition of corn silage, in lot 2, to the corn and alfalfa ration fed to lot 1, made no appreciable difference either in the rate of gain or the return per lamb above feed costs.
4. The addition of linseed meal in lot 3 to the corn, silage, and alfalfa ration which was fed to lot 2 resulted in more rapid gains per lamb. In this trial, the extra gain was not sufficient to pay for the added cost of the linseed meal, as shown by the lower returns per lamb as compared with lot 2.
5. The addition of linseed meal to a ration of oats, silage, and alfalfa hay resulted in increased daily gains and a higher return per lamb above feed costs. One-fifteenth part by weight of linseed meal proved practically as efficient as one-eighth part. Lot 4, 5, and 7.

The results obtained in this trial are not in complete agreement with those obtained last year. Not all lambs respond alike to feed. These lambs were bought out of first hands in Chicago and were not filled heavily. They were especially vigorous and thrifty feeders from the start.

RESIDUAL CHLORATES SOON LOST FROM SOIL

Normal Crop Production Usually Resumed Six Months After Use of These Weed Destroyers

C. R. MEGEE AND R. W. LIPSCOMB, FARM CROPS SECTION

Some kinds of chemical weed killers such as salt and oil exert a residual influence upon the soil, which tends to depress crop yields for a period of from five to ten years. It does not appear that chlorates exert this depressing influence for any considerable period of time, the depressing influence usually being dissipated in from six to eight months.

The following experiment was conducted under three separate divisions as follows: 1—Chlorates applied during the late summer and the crop planted the following spring and summer. 2—Chlorates applied in the spring, land not plowed and the residual influence determined at the various soil depths; namely, 1 to 4 inches; 4 to 8 inches; and 8 to 12 inches. 3—Chlorates applied in the spring, the land plowed, seed bed prepared, and crops planted during the late spring, summer, and fall months. The residual influence at various

depths was also determined. This project was carried out on a heavy loam soil. The results secured are very briefly discussed in the following paragraphs.

Chlorates Applied During Late Summer and Crops Planted the Following Season

Both sodium chlorate and magnesium chlorate were applied one, two, and three times at rates ranging from 100 to 400 pounds per acre. The medium and heavy applications completely eradicated the quack grass. The following season at the usual planting time corn, beans, potatoes, and buckwheat were planted on the areas which had been treated with chlorates. Likewise, untreated areas were also planted. Notes were taken on the rate of germination, rapidity of growth, color of foliage, and yield. There was no apparent difference between the treated and untreated plots. This indicates that when chlorates are applied during the late summer and fall no injurious influence is exerted upon crops grown the next season.

Chlorates Applied in the Spring, Land Not Plowed, and Residual Influence Determined at Various Soil Depths

Atlacide (a commercial mixture of calcium chloride, sodium chlorate, and zinc chloride) and sodium chlorate were used, the applications being at the rate of 400 pounds per acre. About 10 weeks after the chlorates had been applied, layers of soil from one to four inches, from four to eight inches, and from eight to twelve inches deep were removed from both treated and untreated plots and the soil placed in four inch pots in the greenhouse. Beans were planted in these pots, and the rapidity of germination, the vigor of the plants, and the color of the leaves was noted. The plants treated with sodium chlorate received nearly twice as much chlorate (ClO_3) as those receiving Atlacide. In the case of the sodium chlorate pots, the beans showed a decided residual influence at the one to four inch zone, somewhat less influence in the four to eight inch zone and little, if any, influence in the eight to twelve inch zone. The Atlacide pot showed a residual influence in the one to four inch zone, very little in the four to eight inch zone, and none in the eight to twelve inch zone. This indicates that when chlorates are applied in the spring, it does not appear feasible to attempt to grow crops the same summer. It also indicates that it is not advisable to make light applications of chlorates around shallow rooted shrubs or trees, but light applications may be made successfully around deep rooted trees without danger of injuring the trees.

Chlorates Applied During the Spring, the Land Plowed, the Seed Bed Prepared, and the Crops Planted During the Late Spring, Summer, and Fall Months of the Same Season

Atlacide was applied at the rate of 150, 300, and 375 pounds per acre. Also, one area was left which received no treatment. Corn, beans, potatoes, buckwheat, Sudan grass, rye, and wheat were planted on each area at the usual planting date for each crop. Notes were taken on the rates of germination, vigor and growth of the plants, and the color of foliage. As was expected, the crops developed normally on those plots which received no application of chlorates. The corn germinated well on all plots and there was no

marked difference in vigor and color of the young seedlings for the first six days. After this, there was a loss of chlorophyll from the plants on the plots receiving 300 and 375 pounds of Atlacide, but no difference could be noted between the plots receiving 150 pounds and those receiving no application.

After a period of 10 days, the plants on the plots receiving 300 pounds and 375 pounds of chlorates were noticeably smaller than those on the plots receiving 150 pounds and no treatment. At the end of another 15 day period, the plants receiving the two heavy rates of application had reached their maximum growth, which ranged from three to four feet. Several of the plants died outright.

Very little difference was noticeable between the checks where no applications were made and the plots receiving 150 pounds. In fact, at the time of harvesting the yields were practically the same. Yields on the plots receiving 300 and 375 pounds were much lower than those on the plots which received only 150 pounds.

The potatoes were much slower in sprouting on the plots receiving 300 and 375 pound treatments, few tubers were produced and those were about the size of marbles. The plots which received 150 pounds and the check plots produced a fair yield of potatoes of a normal size. There was practically no difference in the yield and size of potatoes on the check plot and on the plots receiving 150 pound application. The beans, buckwheat, and Sudan grass were failures on the plots receiving 300 and 375 pounds of chlorate. There was very little difference between the check plots and the plots receiving a light application of 150 pounds per acre of chlorate.

During the latter part of September, wheat and rye were sown on a portion of a plot which had been fallowed during the summer. The germination, the rate of growth, and the general appearance of both wheat and rye were normal on all plots. No difference could be distinguished between the check plots and those getting the heaviest application of the chlorates. These results indicate that, when chlorates are applied in the spring, it is useless to expect normal production during late spring and summer months of the same season that the chlorates are applied. They also indicate that, when the chlorates are applied in the spring, the residual influence has been dissipated by late September and that rye and wheat may be sown with the expectation of getting normal growth. In another test, chlorates were applied during midsummer, and, in this case, as the residual influence of the chlorate had not been dissipated it was impossible to get a normal growth of wheat the same season.

Conclusions

1. Chlorates applied during the late summer and fall months are not likely to influence crop production the following season. In this project a heavy loam soil was used.

2. When chlorates are applied during the spring, it does not appear feasible to attempt to grow crops during the summer of the year in which the chlorates were applied.

3. When chlorates are applied during the spring, the residual influence is usually sufficiently dissipated by late September so that wheat and rye may be sown.

4. Heavy applications of chlorates penetrate the soil to a greater extent than light applications.

5. Light applications, 150 to 200 pounds per acre, are likely to penetrate to a sufficient depth to greatly injure shallow rooted shrubs and trees.
6. Deep rooted trees, such as mature apple trees, are not likely to be injured by applications of 300 pounds of sodium chlorate per acre.

COTTONSEED MEAL DOES NOT CONSTIPATE DAIRY CATTLE

L. A. MOORE, DAIRY SECTION

Cottonseed meal usually furnishes the cheapest available high protein concentrate for dairy cattle in Michigan. However, it is not heartily recommended by all authorities because certain unfounded prejudices have been formed. One of these prejudices is that cottonseed meal is constipating. However, no attempt had been made by investigators to study this factor experimentally.

The purpose of this investigation was to determine the effect of cottonseed meal as compared to linseed oil meal on the hardness or softness of feces of dairy cattle as an indication of the constipating or laxative effect of these feeds. Linseed oil meal is usually considered as a laxative feed.

In this investigation, a mechanical method was used for measuring the hardness or softness of the feces. Readings by this method gave results in terms of degrees. The larger the reading the softer the feces and vice versa.

Effect of Cottonseed Meal or Linseed Oil Meal When Fed With Timothy Hay and Corn Silage

The hardness or softness of the feces of six Holstein heifers which were from 24 to 30 months of age was determined. These animals are being used on a long time experiment to determine the effects on health and reproduction of heavy cottonseed meal and linseed oil meal feeding. The animals in lot 1 have received cottonseed meal as the principal source of protein, and the animals in lot 2 have received linseed oil meal as the principal source of protein since they were 90 days old. These observations were taken during heavy milk production. The average daily food consumption of the animals during the time the hardness or softness of the feces was determined is shown in Table I. The effect of these feeds on the hardness or softness of feces is shown in Graph I. The results show very little difference in the hardness or softness of feces of the two groups even though the cottonseed meal heifers received from 7.8 to 9.0 pounds of cottonseed meal daily and the linseed meal group received from 6.0 to 12.6 pounds of linseed oil meal daily.

Effect of Nine Pounds of Cottonseed Meal or Nine Pounds of Linseed Oil Meal When Fed With Timothy Hay and Without Corn Silage

The results secured in part I indicated that there was practically no difference in the hardness or softness of feces of cattle fed heavily on cotton-

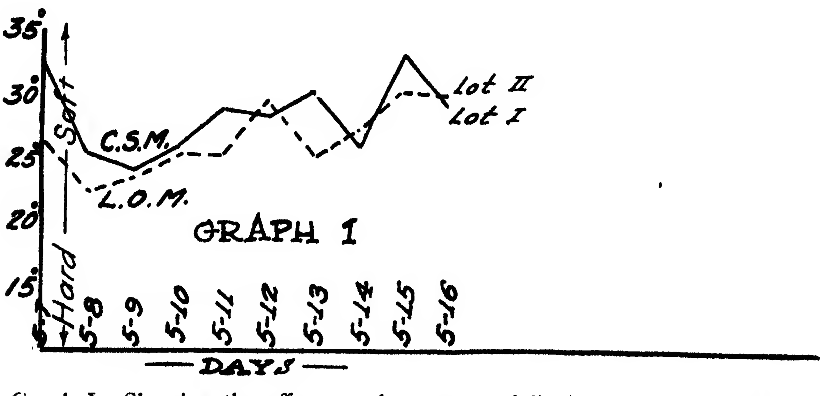
Table I.

Showing average daily food consumption

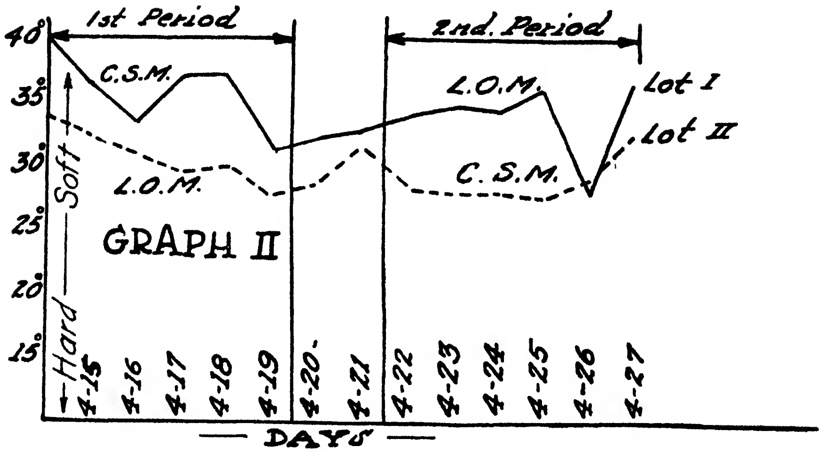
Animal number	Cotton seed meal	Linseed oil meal	Corn	Silage	Timothy hay
	Pounds	Pounds	Pounds	Pounds	Pounds
Lot I:					
G 1	7 8		2	25	14
G 3	9 0		3	25	15
G 5	9 0		3 9	25	12
Lot II.					
G 2		8 2		25	13
G 4		12 6	3	14	13
G 6		6 0	3	18	12

seed meal or linseed oil meal along with silage and timothy hay. Since succulent feed, such as silage, is regarded as having a laxative effect, six mature cows were placed on an experiment to determine the effect of feeding large amounts of cottonseed meal and linseed oil meal without silage.

The cows were divided into two lots of three animals each. The cows in both groups received 4.5 pounds ground corn, 4.5 pounds ground oats each, and all the timothy hay which they would clean up in addition to the protein concentrate. The animals in lot 1 received in addition nine pounds of cottonseed meal daily, while those in lot 2 received nine pounds each of linseed meal daily. A seven-day preliminary period was allowed, during which time the silage was replaced by timothy hay. The hardness or softness of the feces excreted by the two groups was determined daily for six days, after which the animals in lot 1 were fed nine pounds of linseed oil meal and those in lot 2 were fed nine pounds of cottonseed meal daily. Two days were allowed for the change from cottonseed meal to linseed oil meal and vice versa. The hardness or softness of the feces from both groups was then observed daily for six days.



Graph I.—Showing the effect on the average daily hardness or softness of the feces of cottonseed meal and linseed oil meal when fed with timothy hay and corn silage.



Graph II.—Showing the effect on the average daily hardness or softness of the feces of nine pounds of cottonseed meal and nine pounds of linseed oil meal when fed with timothy hay without corn silage.

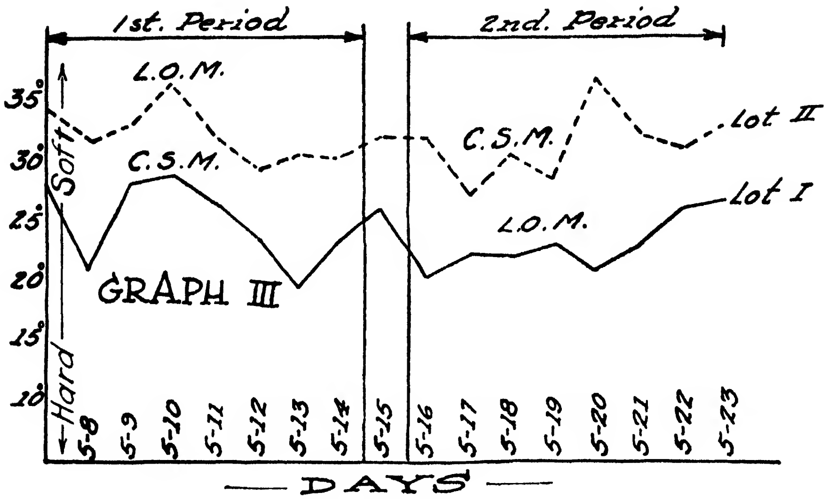
The effect of these feeds on the hardness or softness of the feces is shown in Graph II. It is apparent that there is but little difference between the hardness or softness of feces of animals fed cottonseed meal and linseed oil meal. It is also of interest to note that the change from cottonseed meal to linseed oil meal and vice versa failed to produce a disturbance in the digestive tract. These animals were not accustomed to having cottonseed meal in their ration.

Effect of Only Two Pounds of Cottonseed Meal or Two Pounds of Linseed Oil Meal When Fed With Timothy Hay as a Roughage

The results obtained in parts I and II indicated that the heavy feeding of cottonseed meal did not affect the hardness or softness of feces any more than the heavy feeding of linseed oil meal. However, there was a possibility that the heavy feeding of cottonseed meal caused an irritation in the digestive tract which resulted in a soft feces. In order to determine the effect on the hardness or softness of feces of feeding a small amount of cottonseed meal and linseed oil meal, 6 animals were placed on experiment.

The animals in lot 1 were fed two pounds of cottonseed meal, three pounds of corn and oats daily, with timothy hay for roughage. The animals in lot 2 received two pounds of linseed oil meal in addition to three pounds of corn and oats daily with timothy hay.

A seven-day preliminary feeding period was allowed, after which hardness or softness of the feces was determined daily for eight days. Animals in lot 1 were then fed two pounds of linseed oil meal in place of cottonseed meal, and those in lot 2 were fed two pounds of cottonseed meal in place of two pounds of linseed oil meal. These changes were made in one day. Observations were made daily on the feces for eight days thereafter. The results are shown in Graph III.



Graph III.—Showing the effect on the average daily hardness or softness of the feces of only two pounds of cottonseed meal and two pounds of linseed oil meal when fed with timothy hay as a roughage.

Discussion

Heifers which were raised on cottonseed meal as the principal source of protein from three months of age have excreted, for more than two years, feces which were just as soft as those excreted by animals raised on linseed oil meal for the same period. In this investigation, the amount of cottonseed meal or linseed oil meal did not affect the hardness or softness of the feces.

When silage was left out of the ration in part II and cottonseed meal and linseed oil were fed at the rate of nine pounds per day, no difference could be shown in the hardness or softness of the feces. A sudden change from cottonseed meal to linseed oil meal feeding, and vice versa, had no apparent effect on the hardness or softness of the feces. Cows which were fed only two pounds of cottonseed meal or two pounds of linseed oil meal daily excreted feces of about the same consistency. Apparently, the levels at which cottonseed meal was fed in these rations had no effect on the hardness or softness of the feces.

It is often recommended that cottonseed meal be fed to cows just turned to pasture in order to avoid a too laxative condition. Possibly cottonseed meal in this case acts simply as a regulator. Linseed oil meal would probably produce such an effect also under similar conditions.

Summary

The results of this investigation indicate that cottonseed meal is not a constipating feed for dairy cattle.

The hardness or softness of the feces of dairy cows is not altered by changing rapidly from a heavy cottonseed meal ration to a heavy linseed oil meal ration.

There was no appreciable difference in the consistency of feces between the effects of feeding nine pounds of cottonseed meal compared to nine pounds of linseed oil meal with timothy hay as roughage.

At present prices, the use of cottonseed meal in place of linseed oil meal means the economic saving per year of more than $100,000 to Michigan dairymen.

CHLORATE APPLIED TO FOLIAGE IS MOST EFFECTIVE

Other Methods of Using Chemicals Require More Materials for the Same Results

C. R. MEGEE AND W. H. DAUGHERTY, FARM CROPS SECTION

The increased use of chlorates for the control of troublesome weeds naturally raises the question concerning the most effective method of application. It has been recommended from various sources that chlorate be applied to the foliage, to the stubble after the grass or weeds are cut, be drilled into the soil with a grain drill, or be applied to the surface of the soil. With the thought in mind that these methods of application are not likely to be equally effective, the following experiment was set up in the greenhouse under controlled conditions.

Four different crops were used, quack grass, Bermuda grass, corn and beans. Applications were made by applying sodium chlorate solution to the foliage only, to the stem only, to the soil at the base of the plant, and to the roots through the bottom of the pot. The first application of sodium chlorate was applied at the rate of approximately 100 pounds per acre to corn and beans, and at the rate of 150 pounds per acre to the quack grass and Bermuda grass. Two weeks later a second application of the same strength as the original application was made.

In the case of corn and beans, a very decided chlorophyll loss was noted three days after the chlorate had been applied to the foliage. Similar loss was not noted until after a period of six days when the chlorate was applied to the stem, at the base of the plant, or through the bottom of the pot. Likewise, the corn and beans that received the foliage applications decreased in vigor much more rapidly than those plants receiving the other applications. The bean plants receiving the application on the foliage were dead within 18 days after the first application was made. The bean plants receiving the application by the other methods mentioned were forming new leaves and making an effort to resume growth after a period of six weeks. However, most of the old leaves had dropped off and the plants were not in a vigorous condition. The corn plants in this series were not dead but did not appear as though they would recover.

Loss of Chlorophyll

Quack grass and Bermuda grass plants receiving sodium chlorate applied to the foliage showed a retarded growth before showing a chlorophyll loss.

Five days after the application of chlorate a chlorophyll loss was noted when compared to the check (those plants receiving no chlorate application). The plants which received the application on the stem showed the chlorophyll loss on the sixth day, and the plants where the application was made at the base of the plant or to the roots through the bottom of the pot showed a chlorophyll loss on the ninth day.

Six weeks after the initial application on the foliage, quack grass and Bermuda grass plants were making no growth and had lost practically all of their chlorophyll. Plants receiving their application on the stem, at the base of the stem, or through the bottom of the pots recovered somewhat, most of the leaves were green with very little brown material present.

From the results obtained, it seems that chlorate applied to the foliage is more effective than when applied to the stem, at the base of the plant, or through the bottom of the pot. One of the most practical methods of application is to dissolve sodium chlorate or Atlacide in water and spread this material by means of a hand pressure sprayer. Small patches of troublesome weeds such as quack grass, bind-weed, Canada thistle, and creeping sow thistle may be very effectively and economically controlled by this method.

VALUE OF POTATO SPRAYS AND DUSTS TESTED

Plots Receiving Bordeaux Mixture Made Best Yields in 1929

E. J. WHEELER AND H. C. MOORE, FARM CROPS SECTION

Potato spraying and dusting experiments were conducted in 1929 at the Kellogg Farm, Augusta, and at the Potato Experimental Farm, Lake City. Irish Cobbler seed was used at the Kellogg Farm and Russet Rural seed at Lake City. At each station, there were five one-eighth acre plots used in the tests, the plots were replicated twice.

The liquid spray was bordeaux mixture (4-4-50). The dust material was copper lime dust (25 per cent monohydrated copper dust and 75 per cent chemical hydrated lime).

The bordeaux spray was applied with power sprayers maintaining 250 pounds pressure and delivering approximately 115 gallons of spray per acre. Five applications of bordeaux were made, beginning when the plants were about six inches high and continuing through the season at intervals of two weeks.

Five dust applications (30 pounds per acre per application) were made on approximately the same dates as the liquid spray applications. Dusting was done early in the morning when the vines were moist and the air was still. For Plot No. 5, the copper sulphate dust and the chemical hydrated lime were bought separately and mixed just previous to its application. This dust is described in the table as "Home-Mixed." For the other dusted plots, commercial mixed dust was used.

No outstanding differences were noted in the various plots during the growing season with respect to vigor of growth, freedom from leafhopper, or early blight. Leafhopper injury was apparently not as severe as in previous seasons as the check plots showed very little hopper burn. Severe droughts reduced yields at both Lake City and Augusta.

The plots were harvested in September and October. Yield records were obtained and are presented in Table I.

Table I.

Results of Spray-Dust Experiment, 1929.

Plot number	Treatment	Total yield per acre bushels: Kellogg farm Augusta	Potato experimental farm, Lake City	Average of all tests
1	Check	45 08	71 97	58 52
2	Bordeaux mixture spray	104 51	86 93	95 72
3	Commercial copper-lime dust Power duster	90 67	58 11	74 55
4	Commercial copper-lime dust Hand duster	86 68	66 11	76 39
5	"Home-Mixed" copper-lime dust Power duster	91 85	67 05	79 45
6*	"Instant Bordeaux" spray	..	86 69	.

*Instant bordeaux gave satisfactory results in the Lake City test. Its preparation is simple and does not necessitate the making of stock solutions. The 100 gallon spray tank was filled one-fourth full of water and the agitator was kept working. Eight pounds of powdered copper sulphate were washed through the spray screen and water was added until the tank was three-fourths full. Twelve pounds of chemical hydrated lime were washed through the screen into the tank and water added to make 100 gallons. The agitator was kept running during the entire mixing operation.

Comparison of Data

Bordeaux mixture gave the best yields in both the Kellogg and Lake City tests. The bordeaux sprayed plots outyielded check plots by an average of 37.20 bushels per acre. The average difference in yield between the bordeaux spray and the dusted plots was approximtely 18 bushels per acre in favor of the bordeaux mixture spray. Similar results were obtained in a spray-dust experiment in 1928 where the average yield of all bordeaux spray plots was 173.06 bushels per acre and for all copper lime dust plots 157.29 bushels per acre.

In the 1929 tests, the average yield of dusted plots exceeded that of check plots by 18.27 bushels per acre. In the 1928 experiments, there was a difference of 24.26 bushels in favor of the dusted plots.

A study of the data shows that there is no significant difference in yields between the hand duster and the power duster plots. If care is taken to thoroughly cover the foliage with dust satisfactory results can evidently be obtained with the hand duster outfit. Its use, however, will be limited to small fields.

Results secured with home-mixed dust were as satisfactory as with the

commercial mixed material. The home-mixed dust was cheaper than the commercial mixed dust.

Since home-made bordeaux mixture has consistently given excellent results in the control of leafhoppers and early and late blight of potatoes, its use is recommended for potato growers. Detailed directions for making bordeaux mixture and for spraying methods are given in Extension bulletin 49 and Special bulletin 125 of the Michigan State College.

SEED POTATO DISINFECTANTS COMPARED

Corrosive Sublimate is Recommended for the Control of Scab and Black Scurf

H. C. MOORE AND E. J. WHEELER, FARM CROPS SECTION

A summary report is here given of 1929 potato seed treatment experiments conducted at the Michigan State College; the Kellogg Farm, Augusta; and the Potato Experimental Farm, Lake City. Irish Cobbler and Russet Rural varieties were used in the M. S. C. and in the Kellogg farm tests, while the Lake City experiments included only Green Mountains.

Planting was done the last week in May and the first two weeks in June. Each plot consisted of a single row 40 feet long, replicated three times at the Michigan State College and twice at each of the other stations. The same source of seed was used for the 10 plots in each series of tests.

The method of treatment of the various plots follows:

Plot No. 1 was a check and was planted with untreated seed which was affected with both scab and black scurf.

Plots Nos. 2 and 3 were planted with seed which was free from scab and black scurf. Seed for Plot No. 2 was untreated while for Plot No. 3 the seed was treated with corrosive sublimate one-half hour. The strength of solution used was four ounces of corrosive sublimate to 30 gallons of water.

Plot No. 1 and Plots Nos. 4 to 10 inclusive were planted with seed which was severely affected with both scab and black scurf. Approximately the same degree of scab and scurf infection existed on each of the eight lots of seed.

Plots Nos. 4 and 5 were planted with seed treated with the standard corrosive sublimate solution (4 ounces corrosive sublimate to 30 gallons of water). The duration of treatment for seed in Plot No. 4 was one-half hour and for Plot No. 5 one and one-half hours.

Seed for Plot No. 6 was soaked for two minutes in a hot formaldehyde solution, 1 pint (40 per cent) formaldehyde to 15 gallons of water. The temperature of the solution was 122° F.

Plots Nos. 7, 8, and 9 were planted with seed treated with various organic mercury compounds. The treatments were made in accordance with directions furnished by the companies which manufactured the compounds.

In Plot No. 10, untreated seed was planted and the organic mercury compound was mixed in the soil surrounding the seed piece.

The growing season at each of the three experiment stations was marked by severe droughts which seriously reduced the yields. No significant difference in per cent of stand or vigor of plants was noted for the various plots except at Lake City Plot No. 1 (scab and scurf infected seed untreated) showed a poor stand and a reduced vigor of vine growth.

The Irish Cobbler plots were harvested the first week in September and plots of the late varieties were harvested the first week in October. Records of yield were obtained and counts were made to ascertain the control of scab and black scurf.

A summary of the results obtained at the three stations is given in Table I.

Table I.

SEED TREATMENT EXPERIMENT, 1929.

Average of Results on Kellogg, Lake City, and M. S. C. Plots.

Plot number	Seed treatment	Clean of both scab and scurf, per cent by weight	Clean of scab, per cent by weight	Clean of black scurf, per cent by weight	Total yield per acre in bushels
1	Check (scab and scurf infected seed untreated)	24 8	51 8	76 0	80 9
2	Clean seed untreated	49 9	60 0	77 3	95 4
3	Clean seed treated (cor sub)	52 1	60 8	86 2	92 3
4	Corrosive sublimate ½ hour treatment	39 8	55 4	87 2	92 3
5	Corrosive sublimate 1½ hour treatment	37 4	43 4	89 7	88 8
6	Hot formaldehyde treatment	49 7	61 3	82 4	83 6
	Organic mercury compounds.				
7	DuBay dust.	36 5	54 2	78 2	82 9
8	Cal. K	47 6	55 1	88 7	75 7
9	664	50 1	59 8	91 2	77 6
10	Bayer dipdust mixed in soil around seed pieces	17 6	32 0	85 3	80 5

Discussion

A study of data in Table I shows that Plot No. 3 (clean seed treated with corrosive sublimate) gave the highest per cent of tubers that were free from both scab and black scurf infection. However, since approximately 48 per cent of the tubers in this plot were affected with scab and scurf and only a limited control of these diseases was secured in any of the plots, it is evident that infection through the soil may be a serious factor in scab and scurf control. It will be noted that in all cases the control of black scurf was better than that of scab, indicating that under certain conditions scab infection through the soil may be a serious problem.

Though no significant difference in yields or in the control of scab and black scurf were obtained by the corrosive sublimate, formaldehyde, or organic mercury disinfectants in the 1929 tests it is recommended that Michigan growers continue to treat seed potatoes with the standard corrosive sublimate solution as used in Plot No. 4 of this experiment. No evidence has yet been secured from Michigan State College experiments or field observations to warrant its replacement at this time with formaldehyde or the organic mercury compounds.

RADISH SEED FERTILIZER EXPERIMENTS REPORTED

Michigan Produces Major Portion of United States Crop

BY GEORGE STARK, HORTICULTURAL SECTION

For many years Michigan has produced a large percentage of the radish seed used by the seedsmen and gardeners of the United States. The producing area centers in Antrim county with scattered acreage in nearby counties. The seed is usually grown by the farmer under contract with some seed house at a price ranging from 14 to 18 cents per pound. The crop is produced at a comparatively low expense and, with good yields, there is a fair profit to the grower.

Under very favorable conditions of season, soil fertility, and cultivation, it is possible to produce a crop yielding from 600 to 800 pounds per acre, but it has been noted that for a number of years many fields have been yielding 200 pounds or less per acre, in which case there is little or no profit. A large portion of the crop is grown on rather infertile, light sandy loam soil and with little or no attempt to increase yields through the use of commercial fertilizer.

The 1927 Test

In order to determine to what extent the yield might be influenced through the application of commercial fertilizer, an experiment was started in 1927. The site selected is located near Central Lake in Antrim county. The soil is a light sandy loam rather low in fertility. The field had produced a crop of beans during the preceding year and was in a good state of cultivation. The ground was plowed early in the spring and worked down to a good seed bed. The seed was planted on May 20 in single row plots each row fifty feet long, the rows being spaced two and one-half feet apart. Seed was planted at the rate of three pounds per acre.

Fertilizer was applied to every other row, the intervening rows acting as buffers. In addition, a check row was planted using no fertilizer. Each plot was replicated three times.

Various kinds and amounts of fertilizers were applied to the different plots. The choice of kinds was limited to the types in common use by the gardener and the potato grower and hence of easy access to the radish grower. The fertilizer was distributed evenly along the row immediately after the seed was planted, and was worked into the soil. The seeds germinated rapidly, and, at first, the seedlings appeared to be too thick in the row but an infestation of root maggot uniformly reduced the number of plants which developed so that the final stand was just about right for a maximum crop. Good, clean cultivation was given the plots and all weeds were removed from the rows with a hand hoe.

From the beginning of growth, there were many differences showing between the different rows. The plots having nitrate alone developed a vegetative growth without a heavy set of seed. The rows which received a large amount of phosphorus developed earlier, blossomed more profusely, and

set a heavy seed crop. It was possible without reference to the note book to pick out these rows from their appearance in the field.

When the seed had matured, the plots were harvested separately, threshed, weighed, and individual yields determined. (See table.)

It was planned to repeat this experiment at the same location in 1928 and all of the operations were carried out as in the preceding year. Late in the season, a serious infestation of aphids caused so much damage to the crop that no records were taken.

The 1929 Test

In 1929, similar plots were planted on the experiment station grounds at East Lansing. The soil selected was a rather infertile sandy loam, very similar in many ways to that used in 1927. The field had produced a crop of cucumber seed during the preceding year and was in a good state of cultivation. The ground was plowed early and well fitted. The plots were laid out as in the preceding experiment, each row 50 feet long with buffe rows between each fertilized row. Each plot was replicated three times. A few changes were made in the fertilizer formulae used, some of those which had shown little effect upon the crop were omitted. The seed was planted on May 1 and the fertilizer was distributed along the rows at once and was well worked into the soil. As the final stand of plants per plot in 1927 averaged close to 62 plants, in order to make the experiment more comparable, the plants in the 1929 plots were spaced 62 to the row.

Although the season of 1929 was very dry, the radish plants made a fair crop of seed because the seed was planted early, it germinated very rapidly, and there was sufficient soil moisture during the early part of the season to give the crop a good start. In final yield, it was very much like the crop of 1927. When the seed was mature, the plots were harvested, threshed, and weighed separately. The accompanying table shows the results of the test.

Table 1.

THE RESULTS OF FERTILIZER TRIALS WITH RADISHES IN 1927 AND 1929.

Number of row	Kind of fertilizer	Amount in lbs. per acre	Average number of plants per row	Average yield per plant in ounces	Average yield per row in lbs	Rate of yield per acre in lbs.	Increase in yield per acre over check in lbs.
			1927–1929	1927–1929	1927–1929	1927–1929	1927–1929
1........	4-8-6.. . ..	200	50 66—62	0 448 —0 3475	1 42 -1 35	497 0 -472 5	168 0—154 0
3...	4-8-6	400	66 62	0 4304—0 415	1 78—1 61	623 0—563 5	294 0 -245 0
5...	16% acid phosphate..	200	66 66—62	0 4096—0 3875	1 71 -1 50	598 5 -525 0	269 5- 206 5
7.........	16% acid phosphate	400	62	0 406	1 57	549 5	231 0
9...	2-12-6	200	65 62	0 3984—0 4175	1 62 -1 62	567 0 -567 0	238 - 248 5
11	2-12-6 ...	400	67 55—62	0 416 —0 4350	1 77—1 685	619 5—599 75	290 5—281 25
13.	Nitrate of soda.	200	68 5	0 216	0 93	325 5	—3 5
15	Muriate of potash	200	67 75	0 248	1 05	367 5	28 5
17	Ammonium sulphate	200	60 —62	0 256 —0 245	96— 95	336 —332 5	7 0— 14
19	4-16-4.	200	62	0 385	1 49	521 5	203
21	4-16-4	400	62	0 425	1 65	577 5	259
Check 23.	None.........	......	67. —62	0 224 —0 235	0 94—0 91	329 —318.5	....
Average of buffer rows.	None......	.. ....	65 —62	0 275 —0 312	1 117—1 21	390 95—435 5	61 95—117 0

Nitrate alone encouraged a greater vegetative growth but did not effect a corresponding increase in seed production. Potash alone had little influence on seed production. The use of more concentrated mixed fertilizers, such as 4-16-4, did not effect an increase in yield great enough to pay for their greater cost.

The greatest increase in yield per acre was obtained through the use of 400 pounds per acre of a complete fertilizer. However, as there is so little difference between this yield and that obtained by the use of 200 pounds per acre of the same formula it may be questioned if the use of the larger amount is justified.

It will be noted that the buffer rows having no fertilizer produced a higher yield than the check rows, indicating that a portion of the feeding roots must have entered the area containing fertilizer, hence it is quite likely that in field operations equally good results may be obtained through broadcasting the fertilizer as by applying directly along side of the rows.

SUGGEST METHODS TO CONTROL INLAND SAND BLOWS

Forest Plantations Have Stopped Shifting of Soils in Trials Made by State College

KARL DRESSEL, FORESTRY SECTION

Inland sand blows are sometimes formed on very light sandy soils by a break in the natural vegetative cover. The movement of the sand is often irregular and causes blow-holes and mounds. The drifting sand may do damage by covering roads, ditches, orchards, and farm land so some method of control is desirable. A forest plantation is one of the best means of holding the sand in place.

Experiments in the fixation of shifting sands have been carried on by the Forestry Department of the College for a number of years and many plantings have been made at different times and under various conditions. Last summer studies were made of the growth of the trees and the general condition of some of these plantations and their effect upon the sand.

Ottawa County Trials

A plantation of Norway spruce made in 1915 in Ottawa county on a blow-sand area showed a high percentage of survival. On the slightly better protected spots, the trees averaged 18 inches in height growth per year. On the poorest spots the trees grew very slowly, averaging less than four inches in height growth per year. This plantation stopped the shifting sands from covering the rest of the field. Some of the larger trees were 26 feet in height and 3.4 inches in diameter, breast high, 14 years after planting. On the better types of planting sites in the shifting sand areas, Norway

spruce makes a fine, fast growing, bushy type of tree but on the poorer sites it stunts easily and makes a very slow growth. Norway spruce grows very slowly during the first few years of its life but after once becoming established it grows rapidly. Where the sand is shifting rapidly, it is advisable to sow a crop of rye and then plant the spruce, leaving the grain crop for protection.

Red pine was planted in a deep blow in Ottawa county in 1916 to keep the sand from covering adjoining cultivated fields. The red pine has succeeded very well here and the crowns have almost closed in the 13 years of very adverse conditions. The average height in 13 years is 18 feet although some of the largest trees are 26 feet tall. This plantation at the present time has the sand well under control and will from now on act as a permanent soil cover. A few Norway spruce were also planted on this site but they have done very little; all are small and stunted. The planting site was too poor for this species of trees.

In another place on blow-sand in Ottawa county, the owner is using a number of species, Scotch, Jack, red, Austrian, and white pines, and Douglas fir. In this plantation, which was established in 1925, the Scotch pine has made the best growth on the poorer sites, while the Jack, red, and Austrian pines have not proved so successful. On the fast shifting sand spots, Scotch pine was planted in rye and then brush placed on top of the area as a protecting cover until the vegetation had a chance to establish itself. This method seems to hold the shifting sand very well. The trees were planted in rows 15 to 18 inches apart with three feet between the rows. These trees, four years after planting, are now 8 to 12 inches high with a crown spread of 12 inches. The Douglas fir are rather small and stunted, with an average height of six inches. This is due to two factors, their freezing back the first year and their being planted on a poor site. Wherever the soil and protection is a little better, the trees, regardless of species, are larger, look better, and have a higher percentage of survival.

Effect of Sand Burying Trees

The Harlem sand blow in Ottawa county was planted in 1919 to protect an important drain from being filled by blow-sand. In this planting, many species of trees were used, white pine, Norway spruce, hackberry, black cherry, Jack pine, western yellow pine, soft maple, willow, and poplar. Many of the western yellow pine, willow, and poplar have survived. A very few small stunted Jack pine and Norway spruce still remain but they will soon disappear.

The effectiveness of the trees depends in this case on their ability to withstand sand burying. The willow and poplar cuttings have made the best showing. Some of the poplars have made from 6 to 8 feet height growth a year while the root collars are buried from 5 to 6 feet in the sand. The poplars show a high percentage of survival and now act as a barrier on the leeward side, stopping the blow-sand from drifting into the drainage ditch. The willows have not made quite as fast a growth but seem to withstand the burying action of the sand equally well.

Western yellow pine planted on the windward side has made a good growth and a high percentage of the trees have survived. These trees look very healthy, averaging a foot to a foot and one-half in height growth per year. The bases of many of these trees are covered with drifted sand to a

depth of from one to three feet. Western yellow pine seems to stand burying of the root collar better than most of the conifers but cannot compare in this respect to the willows and poplars.

Some white and Jack pines and Norway spruce still remain in a few protected spots but they are small and stunted, having made an average height growth of three feet in 10 years. The roots of most of these trees have been exposed by the wind and now the root collars stand from three to four inches above the surface of the soil. A few Jack pine, protected by the western yellow pine, have averaged a foot in height growth per year while those in unprotected spots nearby have made an annual height growth of three inches. This difference in height growth of the Jack pine is due to the western yellow pine having protected the roots from being buried by the sand or exposed to the air by the wind. A little protection is often a vital factor in tree growth on the shifting sands.

On a blow-sand area in Muskegon county, ash and soft maple were planted on the leeward side as a barrier to the fast shifting sands which were covering the field on the west. This windbreak is doing a good temporary job of holding back the blow-sand but for permanent fixation the area to the windward must be planted. A small group of western yellow pine made an average height growth of two feet per year. These trees looked healthy and thrifty although growing under rather adverse conditions.

Inland shifting sands can be controlled by the proper use of plant materials, such as grass, shrubs, and trees. In permanent sand fixation work trees should be used and preferably conifers as they act as a barrier through the entire year. The permanent sand fixation planting should start on the windward side of the blow and proceed toward the leeward side. A tree barrier on the leeward side temporarily helps to hold the sand from drifting but is not permanent.

Hardiness of Poplar and Willow

Carolina poplar and willow seem to make the best growth on the blow-sands. Some Carolina poplar have made six to eight feet height growth a year and have had the root crown buried as much as six feet. The per cent of survival of poplar cuttings is usually high. In one planting made last year only four plants out of 100 failed. Poplar and willow will stand more hardships than other species and should be used on the bad areas and as a first-line windbreak to the windward of the blow.

Of the conifers, western yellow pine, Scotch pine, and Jack pine seem to grow best on the very poorest soil and under the poorest protection. Red and white pines do well on the better protected sites. These species grow from one to two feet in height a year after the first few years. Norway spruce in a few cases has made a very good growth on the better soils under fair protection but has also done poorly under other conditions. All the conifers make very little height and diameter growth the first few years after planting on a blow-sand area, but once they become established they should make from eight inches to two feet height growth a year.

In combating inland sand blows the points of attack must first be determined. These are indicated by the general travel direction of the sand. With inland blows there are seasonal winds from different directions. This means that these different sides should come under control simultaneously. Thus, two or three sides may have to be established at the same time, but the

work of sand control should start in all cases on the windward and should progress toward the leeward side.

The small blow-areas may be controlled by establishing a windbreak on the windward side and gradually planting the rest of the area as the force of the wind is broken. The windbreak should be planted a little distance from the blow on solid or non-moving soil. If it is not possible to find non-moving sand toward the windward, a planting of beach grass, rye, vetch, or some other low growing, sand-binding material be established in front of the windbreak.

Planting of Cuttings

Willow and poplar cuttings can be made from local trees. These cuttings should be planted in rows running at right angles to the prevailing winds. The cuttings should be a foot to a foot and one-half long and should be set fairly closely together. They should be set deeply enough to insure the roots being in moist sand. The rows of cuttings should be planted about three feet apart over an area about 12 feet wide. Behind the windbreak, alternating trees of poplar or willow should be interspersed with spruce or pine. These should be set in rows from four to five feet apart and as closely together.as needed. The planting should continue to the leeward as fast as the force of the wind is broken.

Conifers make the best permanent forest cover on exposed sand because they act as a windbreak both in summer and winter, and, in Michigan, most of our serious sand shifting comes in the winter when deciduous trees do little good. Conifers, however, are not likely to succeed when planted alone on shifting sand, especially if the blow is at all large. This is due to their slow starting growth, heavy top, and large transpiration of water. On small blow areas, where it is possible to establish a windbreak on solid soil a short distance to the windward of the blow, a permanent planting of pine or spruce may be started to act as a windbreak. The shifting sand area may be covered with a cover of brush, or hay for a year or two to keep it in control while the windbreak is becoming established. In some cases, grape cuttings have been established and successfully held the shifting sands.

As the windbreak grows and reduces the force of the wind, the planting should be continued to the leeward until the entire area is under a permanent evergreen cover. In some places, a fast growing windbreak has been planted on the leeward side of the shifting sands and the evergreen planting placed to the windward. This method allows the wind a full sweep through the blow, blowing out, burying, or cutting off the small trees with a sand blast. The windbreak may stop the sand for a short time, but it is not permanent and does not keep the blow from enlarging in size toward the windward.

Many species of trees have been planted on inland sand blows. On some locations one species has proven better suited to the conditions. On other sites, other species are best; but, with all species, the better the soil and protection, the better the growth of the trees.

THE STRAWBERRY ROOT-WEEVIL AS A PEST IN CONIFER NURSERIES

BY E. I. MC DANIEL, ENTOMOLOGICAL SECTION

During the spring of 1929 the strawberry root-weevil, *Brachyrhinus (Otiorhynchus) ovatus*, appeared as a major enemy of young evergreens in one of Michigan's largest conifer nurseries. This common insect, unfavorably known for its attacks on strawberries, has apparently never before appeared in sufficient numbers in Michigan to be considered of any very great economic importance. The pest is ordinarily known as the strawberry root-weevil and sometimes as the strawberry crown-girdler. Its attack on seedlings and young trees in the conifer nursery, therefore came as a surprise since very few attacks of this kind appear to have been recorded.

The adult beetle is about a quarter of an inch long or perhaps a little less, and its appearance is clearly shown in Fig. 1. It is reddish-brown in color,

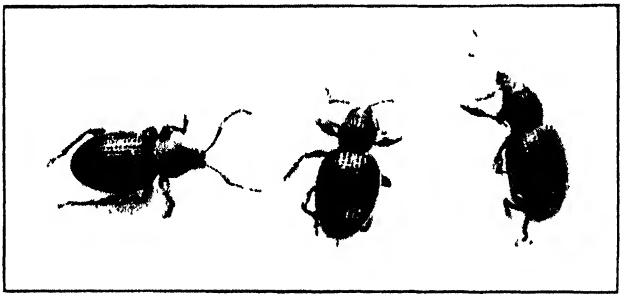


Fig. 1. Adult beetles of strawberry root-weevil enlarged about three times.

sometimes appearing almost black. It has all the appearance of an ordinary flying beetle but true wings are practically lacking and consequently the beetle is unable to fly but must make its way on foot wherever it goes.

The larvae live underground. Their appearance is shown in Fig. 2. In size they measure about a quarter of an inch or perhaps less in length. Both larvae and adults are general feeders. The species usually breeds in old established grass sod, being found commonly in cemeteries, parks, and lawns which have been maintained in grass for a period of years. Strawberry beds are often infested, especially beds that have been planted for three or four years.

Dr. Britton,[1] State Entomologist of Connecticut, reports it as attacking hemlock from twelve to eighteen inches high, in nursery rows. Dr. Trehern[2]

[1]Dr. W. E. Britton,—Connecticut Agricultural Station Report for 1909-1910, page 370.

[2]R. C. Trehern, Bulletin No. 18, Second Series, Dominion of Canada, Department of Agriculture, 1914, page 19.

records the adult as attacking hemlock, while the larvae were found feeding on the roots of both hemlock and balsam. Dr. Paul Spessivtseff[3] records an outbreak in Sweden, in 1923, somewhat similar to that which occurred in Michigan in 1929.

In the case of the 1929 outbreak, the first indication of trouble was apparent when spruce seedlings from three-year-old seed beds were being removed for transplanting and shipping. At this time, a careful examination showed that the bark for an inch or two below the soil level, had been stripped from the main roots in large patches so that the roots in some cases were completely girdled. Plants so injured, had in some cases, tried more or less successfully to develop a secondary root system above the injury. Fig. 3. At least two-thirds of the three-year-old Norway spruce seedlings in this particular nursery were injured to such an extent that the plants were worthless, and practically all of the seedlings showed some injury.

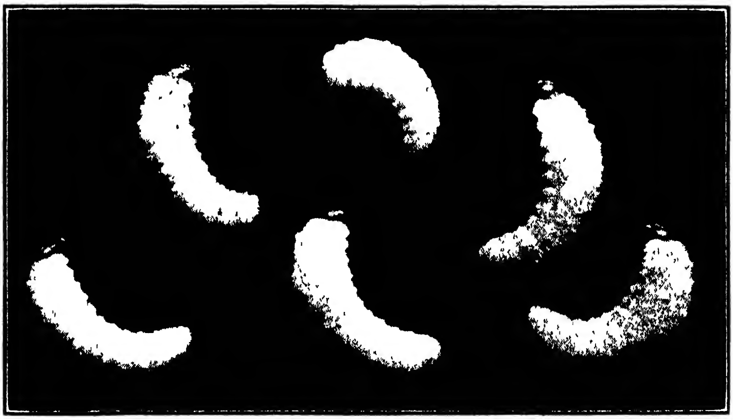


Fig. 2. Larvae or grubs of strawberry root-weevil enlarged about four times.

The white larvae of *Otiorhynchus* were present in these seed beds in almost unbelievable numbers from the 8th of April to the 25th of May at which time the majority began to pupate. The infestation was most severe in seed beds of three-year-old Norway spruce, but larvae were found producing their characteristic injury in all other conifer seed-beds in the nursery. These included beds of western yellow pine, white pine, jack pine, red pine, white spruce, Japanese larch, American larch, and arbor vitae, the most serious injury occurring in beds that were three years old. The damage also occurred to a lesser degree in the two-year-old beds. Older trees, still in the nursery rows, were attacked as well, but less seriously because their better developed root systems were able to withstand an attack of this kind. Among the various species of conifers attacked, those having a branching root system were also better able to withstand injury. On the 8th of April larvae were found at all depths from one to twenty inches, but later by the middle of May, they had migrated to considerably nearer the surface, and begun to form the cells in which they pupated.

[3]Dr. Paul Spessivtseff,—Bidrag Till Kannendomen om Bruna.

The first adults captured as they were emerging from the ground were taken on the third of June. Observations throughout the season revealed that there is but one generation a year, though the adults live for a year or more. Some of the individuals lay eggs both in the fall and in the spring. The winter is passed both in the larval and in the adult stages. The greatest injury is done by the larvae in early spring just before pupation takes place.

Fig. 3. Spruce seedlings, showing roots denuded of bark by larvae of strawberry root-weevil. Slightly reduced.

Control

No very satisfactory control methods have been discovered either in this country or abroad, that is, measures which will work efficiently in conifer nurseries. Strawberry growers avoid serious injury by employing a carefully worked out system of rotation and late fall cultivation of land which is later to be planted to strawberries.

An extensive series of experiments with soil insecticides is now being carried on in the hope that some effective killing agent may be discovered. In the absence of entirely satisfactory control measures, growers may obtain some relief by taking up their two-year-old seedlings in the fall and storing them in cellars until the following spring, since the most destructive period

through which the seedling passes, is during the spring of the third year. The roots of trees which are taken from infested nurseries can be cleared of the larvae by washing, after which the roots may be puddled and the trees shipped safely. No doubt this beetle works on larger trees quite commonly and a fair sized vigorous tree is able to withstand attacks which would kill young trees.

THREE NEW GRAPE VARIETIES RECOMMENDED

Trials Made Indicate These Sorts Will Suit Michigan Conditions

BY H. M. WELLS, HORTICULTURAL SECTION

Among the newer grape varieties under trial at the Graham Horticultural Experiment Station near Grand Rapids are three which appear promising enough to warrant further trial under a number of Michigan conditions. Short historical and descriptive statements and comments on their behavior under the environment in which they have been growing, follow.

Urbana

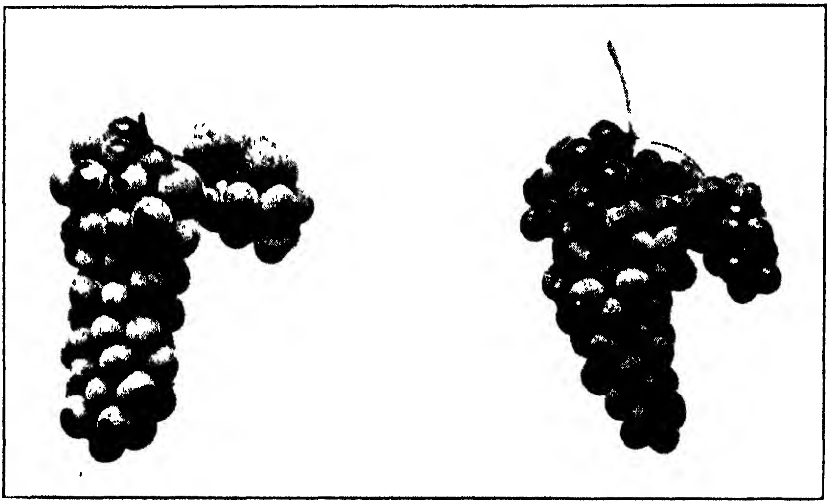
This variety is the result of a cross between Ross and Mills. It was originated and named by the New York Agricultural Experiment Station and was introduced by them in 1912. The vines are vigorous, productive, and reasonably hardy. The bunches are medium to large and are attractive. The berries are large, light red and have a thick skin which adheres somewhat to the pulp; the flesh is firm, juicy, and aromatic with a rich refreshing taste. In season it ripens after Concord, which automatically limits its culture to the more southern sections of the state where the growing season is reasonably long and warm.

Toilkins

Toilkins originated on the trial grounds of the Dominion Experimental Farms at Ottawa, Canada. The vine is vigorous, very productive, reasonably hardy and it matures its fruit at about the same season as Campbell Early or Portland. The bunches are medium to large in size, are often shouldered and somewhat pointed, and vary from loose to compact. The berries are round, of medium size, light green with light bloom; the skin is tender and separates readily from the pulp; the flesh is moderately firm, juicy, tender, sweet, and very aromatic; the quality is medium to good. As a commercial variety, Toilkins is too tender to handle and ship well; however, where a good white grape is desired for marketing at the roadside or for a strictly local trade, this variety should be tried.

Butler

Butler was originated by P. W. Butler of Fairport, New York, about 1890. It is thought to be a seedling of Agawam or Brighton. It has been under trial at the New York Agricultural Experiment Station for a number of years and has recently been distributed by the New York Fruit Testing Association. At the Graham Horticultural Experiment Station, it has stood out as one of the best red grapes for productivity and quality. It resembles Brighton in many respects but produces larger and better bunches than that variety. The vine is vigorous, hardy, and relatively productive. The fruit ripens about midseason; the clusters are medium to large, broad, often shouldered. They vary from loose to very compact and are comparatively



Typical bunches of the Urbana (left) and Butler (right).

attractive. The berries are medium to large in size, light to dark red, and covered with heavy bloom. The skin separates readily from the pulp; the flesh is juicy, aromatic, and of good quality. Where a good red grape is desired, this variety should be given a trial.

Recommendations

Though at this time these varieties cannot be recommended for extensive commercial planting in Michigan, they possess certain desirable characteristics that warrant their trial where grapes of their several types are desired. In some of the more favored sections of southern Michigan, the Urbana will probably mature properly year after year. Butler and Toilkins are promising for trial in any part of the state where the present commercial varieties mature well.

GOOD PRACTICES INCREASE YIELDS OF PASTURE

Use of Complete Fertilizers Give Excellent Results on Michigan Fields

M. M. MC COOL AND M. D. WELDON, SOILS SECTION

Considerable publicity has been given recently concerning the use of fertilizers in the improvement of pastures. The results of numerous field trials in this and certain foreign countries show that the feeding value and the carrying capacity of pastures may be increased appreciably by proper management practices.

We have conducted pasture experiments on several soil types in southwestern Michigan during the past two years. The results obtained to date indicate that the application of commercial fertilizers in the right amounts and in proper mixtures are profitable. Plowing, reseeding, and fertilizing are successful where the stand is poor and the turf not well developed.

Although a rather elaborate study is being made of the effect of soil treatment on the yield and composition of herbage, we shall not present all of the results obtained at this time.

Two sets of plots were established in Kent county. One field in the northern part of the county was a run-down, over-pastured sod, mainly Kentucky bluegrass, on Isabella sandy loam soil. The other field in the southern part of the county was a dense, vigorous Kentucky bluegrass sod on Miami loam.

The fertilizers were broadcast on the sod in April at the rate of 300 pounds per acre. The fertilizer mixtures used and the results obtained are indicated in tables 1 and 2. All of the mixtures were applied in 1929 except in the case of the last two plots, which were fertilized as indicated in the tables. The yields were obtained by mowing the plots with a lawn mower as often as necessary and by weighing the clippings so obtained.

The figures set forth in tables 1 and 2 indicate that complete fertilizers, containing nitrogen, phosphoric acid, and potash gave greater results than fertilizers containing only one or two of these nutrients. On each field, the largest yields were obtained by the use of the 5-12-4 mixture. The formulas containing 10 per cent of nitrogen were less effective than those containing 5 per cent. A smaller amount of phosphoric acid than 12 per cent was insufficient for maximum yields. The value of the potash in the mixture was especially evident on the Isabella sandy loam soil, where the plots receiving potash averaged nearly twice as much increase in yield as those receiving no potash.

The use of nitrogen alone or of phosphoric acid alone gave unsatisfactory increases in yield; in fact, in two cases, an actual decrease was found to occur. The fertilized plots yielded less than the unfertilized plots.

Applying the phosphoric acid and potash at double the usual rate the first season and omitting them the second season seemed to be about as effective

Table 1.

Fertilizer results with pasture grass on Isabella sandy loam near Sparta, Kent County.

Treatment	Increase in yield, pounds of green feed per acre	
	In 1928	In 1929
5-6-4	1725	1950
5-12-4	2025	2455
10-12-4	1400	1345
10-6-4	1315	1015
10-6-0	515	715
10-12-0	815	1155
10-0-0	375	210
0-6-0	360	120
10-12-8 in 1928 10-0-0 in 1929	1190	1360
10-24-0 in 1928 10-0-0 in 1929	1260	770
Average yield of unfertilized plots	2440	3540

Table 2.

Fertilizer results with pasture grass on Miami loam near Caledonia, Kent County.

Treatment	Increase in yield, pounds of green feed per acre	
	In 1928	In 1929
5-6-4	2335	1825
5-12-4	2670	2595
10-12-4	2535	2050
10-6-4	2240	1605
10-6-0	1540	1425
10-12-0	1525	1590
10-0-4	1690	380
0-6-4	1160	1535
10-0-0	1015	−475 (decrease)
0-0-0	−400 (decrease)	865
10-12-8 in 1928 10-0-0 in 1929	2240	1798
10-24-0 in 1928 10-0-0 in 1929	2980	2340
Average yield of unfertilized plots	5380	3725

as applying the usual amount each spring. The plots which received 10-12-8 in 1928 and nitrogen alone in 1929 made a slightly better showing than those which received 10-6-4 in both years, although the total amount of fertilizer used was the same in each case. Likewise, the plots which received 10-24-0 in 1928 and nitrogen alone in 1929 made a slightly more favorable showing than those receiving 10-12-0 in both seasons, the total amount of fertilizer applied being the same in each case.

A comparison of yields on the unfertilized plots of the two fields for the two seasons reveals that in 1928 the Caledonia field produced more than twice as much grass per acre as the Sparta field, while in 1929 the yields

were nearly the same for the two fields. The high yields on the Caledonia field in 1928 were due mainly to the fact that the pasture had never been overgrazed. The bluegrass had formed a dense sod which crowded out all weeds, and had been able to store food reserves each year in readiness for a vigorous growth the following one. The low yields on the Sparta field were due to the opposite condition; overgrazing had prevented the tillering of the grass, the formation of a dense turf, and the storage of food reserves during the summer and fall, so that the grass came through the winter in a weakened condition, unprepared for rapid vegetative growth in the spring.

During the season of 1928, however, both fields were managed in the same way, so they entered the winter and started growth in the spring in similar condition. They produced nearly equal yields in 1929. The Caledonia field was cut more closely in 1928 than it had been previously, so that its production was decreased during the following season. The Sparta field was permitted to grow more freely in 1928 than it had been previously, so that its production was increased during the following season. The two fields which were apparently widely different in fertility in 1928 had thus become quite similar in productiveness as a result of similar treatment during a single growing season.

It may be concluded from these and other facts on record that moderate grazing will lead to greater production than close grazing. It has been commonly observed that an over-pastured sod not only produces less feed, but also is likely to become infested with weeds such as mullein, ragweed, and daisy.

The use of fertilizers may influence the character of the vegetation to some extent. This was observed on each of our experimental pasture fields, but especially on the Caledonia field, where the application of superphosphate increased the relative amount of clover in the herbage, while nitrogen fertilizer decreased it. An estimate of the percentage of clovers, which were mainly white clover and alsike, in the herbage was made at the time the yields were taken in May, 1929. The results are presented in Table 3.

Table 3.

The effects of fertilizers on the percentage of clover and yield of herbage on the Caledonia field.

Treatment	Clover percent present in May, 1929	Yield, pounds of green feed per acre in 1929
None	20	4770
Nitrogen	5	4415
Phosphorus	50	6365

It is worth noting that in 1928 the yield on the superphosphate plot was slightly less than on the unfertilized plot, while in 1929 it was considerably greater. This improvement may be due, in part at least, to the greater supply of nitrogen made available by the presence of the clover during the second season.

Great improvement in pasturage has been effected by plowing and reseeding. This has been observed in a number of cases. A part of the

Sparta field was a mixture of pasture grasses and legumes plowed and seeded with a nurse crop of oats in 1928. A fair yield of oats was obtained, and the next spring a splendid growth of grass resulted, far greater in fact than was secured by the use of fertilizers on the original sod.

Similar results of reseeding were obtained on a Cass county field. The field was a bluegrass sod which had been more or less destroyed by hogs. In the fall of 1928, it was plowed and seeded wth a suitable pasture mixture. Clipping was necessary twice during the season to control the weeds, but a good, productive stand was obtained which produced a much larger yield of valuable pasturage than adjacent fields which had not been so treated. The use of fertilizers made the seeding more productive than seeding without fertilizer.

These and other observations lead us to believe that plowing and seeding is the most effective single method of increasing the production of pasturage That is where the stand is poor and the turf not well developed. How frequently this operation will be desirable can be decided only by additional observations.

The data which have been presented indicate that a complete program of pasture improvement should include all or most of the following features:

1. Plowing, if practicable, and seeding with a suitable mixture of pasture grasses and legumes where the stand is not good.
2. The use of fertilizers at the time of seeding, and the use of lime on strongly acid soils.
3. Top-dressings of suitable fertilizers to maintain productiveness and a desirable type of herbage.
4. Judicious grazing to maintain a well-developed, vigorous turf
5. Occasional mowing to discourage weeds.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

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Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
80 Yellow Rocket (a dangerous weed).
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
129 Bean Growing in Michigan.
130 The Clovers and Clover Seed Production in Michigan.
133 Fertilizers. What they are and how to use them.

134 Greenhouse Insects.
135 Seasonal Management for Commercial Apiaries.
136 The Muck Soils of Michigan.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
168 The Management of Michigan Muck Soils for Onion Production.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
178 Michigan Raspberry Diseases.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.
182 Strawberry Growing in Michigan.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

183 Common Pests of Field and Garden.
184 Size of Peaches and Size of Crop.
185 Roadside Marketing in Michigan.
186 Chrysanthemum Breeding.
187 What Makes Some Farms Pay.
188 Pollination of Orchard Fruits in Michigan.
189 The Marketing of Michigan Milk.
190 Oak Forests of Northern Michigan.
***191 Barley for Michigan Farms.**
***192 Causes and Effects of Soil Heaving.**

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34 More Wheat for Michigan.
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48 Spraying for Hopperburn.
49 The Hessian Fly.
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53 Standard Fertilizers for Michigan.
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61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
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69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
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75 Fertilizer Suggestions for Ingham County Soils.
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85 Honey Vinegar.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.

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Quarterly Bulletins—

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Vol. VI, No. 4, May, 1924
Vol. VII, No. 2, November, 1924
Vol. VII, No. 3, February, 1925
Vol. VII, No. 4, May, 1925
Vol. VIII, No. 2, November, 1925
Vol. VIII, No. 3, February, 1926
Vol. VIII, No. 4, May, 1926
Vol. IX, No. 1, August, 1926
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Vol. XII, No. 2, November, 1929
Vol. XII, No. 3, February, 1930

Extension Series Bulletins—

2 The Babcock Test.
13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
22 Effective Crop Exhibits.
23 Alfalfa.
24 Utilizing Poles and Timber in Farm Buildings.
25 Feeding Cull and Surplus Potatoes.
26 Swine Feeding.
27 The Kitchen Sink.
31 Capons.
32 Bull Pen and Safety Breeding Chute.
***33 Bigger Dairy Profits Through Dairy Herd Improvement Associations.**
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53 Chick Diseases in Michigan.
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55 Plowing for European Corn Borer Control.
56 Renting or Keeping Bees for Use in the Orchard.
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76 Some Common Sucking Insect Pests of Evergreens.
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78 The Fruit Tree Leaf Roller.
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82 Growing String Beans for the Canning Factory.
83 Growing Peas for the Canning Factory.
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2 Potato Club Work.
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9a Clothing Club Work.
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12 Hot Lunch Club.
16 Michigan Club Songs.
17 Dairy Club Work.
18 Poultry Club Project.
19 Forest Planter's Handbook.

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32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.

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50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
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64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.
65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).
66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
67 Investigations on the Blackleg Disease of Potato.
68 Bacterium Pullorum.
69 The Fruiting Habits and Pruning of the Concord Grape.
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75 Influence of Nutrient Supply on Earliness of Maturity in Cabbage.
76 Concentration of Materials and Rates of Application in the Control of Apple Scab.
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79 Tests for Incipient Putrefaction of Meat.
80 Virus Diseases of Raspberries.
81 Storage and Transportational Diseases of Vegetables Due to Suboxidation.
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95. Studies in Flax Retting.
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97 Studies of the Overwintering and Modes of Infection of the Fire Blight Organism.
98 Further Studies on the Values of Non-Virulent Living Culture Vaccination of Cattle Against Brucella Abortus Infection.
99 Defective Graft Unions in the Apple and Pear.
***100 The Differentiation of the Species of Genus Brucella.**
***101 A Test For Water-soluble Phosphorus.**

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Special bulletins are of a popular nature, and deal with special lines of work.

Circulars are briefly and concisely written discussions of a popular nature.

Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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Chatham, Alger County, 780 acres deeded, G. W. Putnam, Direct[illegible]
South Haven, Van Buren County, 10 acres rented; 5 acres de[illegible] [illegible]ent.
Graham Station, Kent County, 50 acres donated by [illegible]
Superintendent.
Dunbar, Chippewa County, Forestry Sta[illegible]
Lake City Experimental P[illegible]
[illegible]ley Berridge, Sup[illegible]
[illegible]emon[illegible]

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CONTRIBUTIONS BY ALL SECTIONS OF THE AGRICULTURAL EXPERIMENT STATION

ICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
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FERTILIZING THE BLACK RASPBERRY

Applications of Nitrogen Result in Heavier Early Season Production and Increased Income per Acre

ROY E. MARSHALL, HORTICULTURAL SECTION

Fertilizer trials with both black and red raspberries were begun by the Horticultural Section as early as 1921 and have been continued in various fields since that time. None of these tests was productive of results unquestionably favorable to the use of fertilizers, but the layout of plots and the soil uniformity, as indicated by raspberry plant growth or other factors, were not of such a nature as to warrant a critical analysis of results and the formulation of conclusions based upon small differences between treatments.

In the early summer of 1926, an apparently uniform field of healthy and fairly vigorous two-year-old plants was located near Covert. A fertilizer experiment was planned in which emphasis was to be placed on the time of application of nitrogen which was in a quickly available form rather than kinds of materials. The treatments were planned in triplicate except for those with acid phosphate, which were in duplicate, and another unreplicated treatment for which the results were discarded because of an insufficient number of plants.

In early August, 1926, just after harvest, sulphate of ammonia was applied to three regularly interspersed rows at the rate of 240 pounds per acre. A similar application was given another lot of rows about September 10. The same material, at the same rate, was applied as another treatment in the spring of 1927, and, at this same time, another lot of rows received sulphate of ammonia at the rate of about 480 pounds per acre. Also, at this time in the spring, two rows were fertilized with acid phosphate at the rate of 600 pounds per acre. Another treatment consisted of sulphate of ammonia at the rate of 240 pounds per acre applied when the berries were turning red. Still another set of rows were unfertilized. These fertilizer applications were ·:peated annually until the end of the experiment in 1929.

This field wa< ven better than average cultivation and weed control was very good ur :9 when spring rains interfered with cultural practices. The prun' ione by the owner of the field and was essentially that described i.. gan Experiment Station Special Bulletin No. 143 except that the fruiti.. laterals were left a little longer than is advocated for "short" pruning. The soil was better than the average for the district, the particular location of the plants used in this experiment being on the lower portion and at the base of a gentle south slope, so that approximately equal portions of all rows were located on the slope and on the level area. Anthracnose was kept under commercial control until 1929 when it prob-'.

resulted in somewhat lower yields for the field as a whole. A few diseased plants were discarded, and, in a few cases, plants found to be of varieties other than Cumberland were also eliminated.

Color of Foliage

Beginning with the picking season of 1927 and continuing throughout the duration of the experiment, color differences in the foliage of rows receiving the different treatments were very outstanding, more so than the writer has noted between similar treatments with tree fruits. The foliage of the rows which were fertilized with sulphate of ammonia in the spring or in September was a rich dark green. That of the rows fertilized after harvest was a little lighter in shade than for the treatments just mentioned. The unfertilized plants and those fertilized with phosphorus in the spring or with nitrogen when the berries were turning red produced yellowish foliage and some of the leaves of the fruiting laterals was more or less bronze in color. It was estimated that 85 to 100 per cent of the leaves of the last three named treatments were yellowish, while a similar percentage of the leaves of the first group of treatments were dark green. In 1927 and in 1928, these contrasting differences between the rows were conspicuous to growers driving by the field (the rows ran at right angles to the highway) but, in 1929, these apparent differences between treatments were not as marked, probably because of the greater prevalence of anthracnose and weeds.

Yields and Returns per Acre

The rows in this field were seven feet apart and the plants were four feet apart in the row. A full stand would give 1,555 plants per acre but, in calculating the results in this experiment, a 90 per cent stand or 1,400 plants per acre is assumed. Individual plant yields were obtained and transposed to an acre basis. In calculating the returns per acre, canning factory prices of 9, 8, and 8½ cents per pound for 1927, 1928, and 1929, respectively, were used. The cost of the fertilizers applied has been deducted, although no charge has been figured for labor in applying same. Sulphate of ammonia was figured at $65.00 per ton and acid phosphate at $35.00. Even though some exception may be taken to the values used in calculating the results, the relative differences between treatments would remain essentially the same.

Table 1.--Yield of black raspberries in pounds per acre

Treatment	1927	1928	1929	3-year Average
Nitrogen in spring	3,496	4,578	2,027	3,367
Nitrogen when berries red	2,859	4,164	2,131	3,051
Nitrogen after harvest	3,526	4,315	1,829	3,223
No fertilizer	3,033	4,365	2,014	3,137
Nitrogen early September	3,661	4,277	2,243	3,394
Nitrogen in spring, double amount	3,157	4,259	2,290	3,235
Phosphorous	3,024	4,091	2,102	3,072

The yields per acre obtained with the different treatments were lowest with the unfertilized treatment, with phosphorus applied in the spring, and with nitrogen applied in early summer or when the berries were turning red,

except that the unfertilized plants produced the second highest yields in 1928. The differences in yield between treatments, however, are relatively small and it is doubtful if much significance can be attached to them. In other words, they are not greater than the range in yields that might be expected had all plants been given the same treatment. The very fact that the three treatments produced rather uniformly low yields lends weight to the assumption that there was at least a tendency for the plants fertilized with nitrogen in early August, in September, or in the spring to consistently outyield the unfertilized plants, the plants which received phosphorus, or those fertilized with nitrogen when the berries were turning red.

The average annual yields of this field were very high compared to others in Southwest Michigan (for comparison, see Mich. Exp. Sta. Special Bulletin No. 165). This may be an indication that this particular soil did not need fertilizers to produce satisfactory crops of raspberries and may mean that little information relative to the fertilizer requirements of average fields can be obtained from this experiment.

The high yields of 1928 were probably due to the rather high summer rainfall for that year, 2.76 inches for the period beginning one week before picking and extending through the harvest season. This was the year when the berries were large and so soft that the canning factories refused to accept them during the latter part of the picking season. The low yields for 1929 may be accounted for by the greater prevalence of both weeds and anthracnose and low picking-season rainfall, 1.01 inches for the period similar to that described for 1928.

Table 2.—Returns per acre. Cost of fertilizers deducted

Treatment	1927	1928	1929	3-year Average
Nitrogen in spring	$306 64	$358 24	$164 29	$276 39
Nitrogen when berries red. . .	249 31	325 12	173.13	249 18
Nitrogen after harvest .	309 34	337 20	147 46	264 66
No fertilizer .	272.97	349 20	171 19	264 45
Nitrogen early September	321 49	334 16	182 65	279 43
Nitrogen in spring, double amount	268 13	324 72	178 65	257 16
Phosphorous	261 66	316 78	168 17	248 87

In calculating the returns per acre, it was assumed that all of the 1928 crop was marketed at the usual price; as a matter of fact, there was no market at the canning factories for the mid-season to late pickings and they were not harvested in many fields. The figures in Table 2 show more strikingly than those in Table 1 that from the standpoint of total season yields and returns it probably did not pay to apply fertilizers to this field. For the three-year average, the largest returns per acre (nitrogen applied in September) were only $14.98 higher than those for the unfertilized plants, and only two treatments gave returns that were materially larger than those from the no fertilizer treatment.

Earliness of Maturity

The berries from all treatments were picked on the same days and the number of pickings were the same for all treatments in any one year. The length of the picking season for each year was similar, 21 to 22 days. There were fewer pickings in 1928 than in other years, partly because of more frequent rains.

Table 3.—Yields and returns per acre for early season pickings

Treatment	First picking			First third of season		
	Pounds	Crates	Net Returns	Pounds	Crates	Net Returns
Nitrogen in spring	486	22.1	$36.29	1461	66.4	$113.17
Nitrogen when berries red	422	19.2	32.87	1252	56.9	97.71
Nitrogen after harvest .	551	25.0	41.88	1428	64.9	109.65
No fertilizer . . .	367	16.7	30.93	1191	54.1	97.32
Nitrogen early September.	709	32.2	56.66	1642	74.6	130.13
Nitrogen in spring, double amount	627	28.5	45.24	1525	69.3	111.70
Phosphorous	329	14.9	22.84	1146	52.1	91.34

Each year a marked difference was noted in the early season yields from the several treatments. Table 3 shows the average yields from the first picking for the three-year period. All nitrogen treatments show a gain over the yields for the unfertilized plants and at least four of them appear to be significant. Inasmuch as high early season yields would be of greater benefit to the grower that produces for the fresh fruit market, the yields are also shown in terms of 16-quart crates per acre. The returns per crate are frequently high during the early portion of the season and decline somewhat toward the end of the season. On the basis of actual f. o. b. prices for the first Michigan berries, less the cost of containers, the returns per acre after deducting one-half the cost of the fertilizer are given in the fourth column.

Fig. 1.—Relative first picking yields for the three year period following the initial application of fertilizers. The treatments were as follows: No. 1, sulphate of ammonia applied September 10; No. 2, sulphate of ammonia applied in the spring at the rate of 480 pounds per acre; No. 3, sulphate of ammonia applied just after the last picking; No. 4, sulphate of ammonia applied in the spring; No. 5, sulphate of ammonia applied when the berries were turning red; No. 6, unfertilized; No. 7, acid phosphate applied in the spring at the rate of 600 pounds per acre. Applications other than those for which the amounts are given were at the rate of 240 pounds per acre.

Similar data are presented for approximately the first third of the picking season. Actually, these figures are based on the first three of the nine pickings of 1927, the first two of the seven pickings of 1928, and the first three of the ten pickings of 1929. In this portion of Table 3, the entire cost of the nitrogen fertilizer has been deducted in the "Returns" column. The prices used were the actual f. o. b. ones for each date when pickings were made, less the cost of containers. These figures, as well as other more

detailed analyses of the data, show that nitrogen applied in September materially increased the early season yields and returns. Nitrogen applied in the spring at the rate of 480 pounds per acre also gave substantial early season increases in yield but the additional cost of the fertilizer does not leave a return essentially different from that for the 240 pound spring application.

Since there were no substantial differences in the yields of treatments for the season, any treatments resulting in high early season yields also resulted in low late season yields. This means that the returns from later pickings were higher for the unfertilized plants, those fertilized with phosphorus, and those fertilized with nitrogen when the berries were turning red, and that the differences shown in the last column do not represent actual season differences. The average annual net returns per acre on a

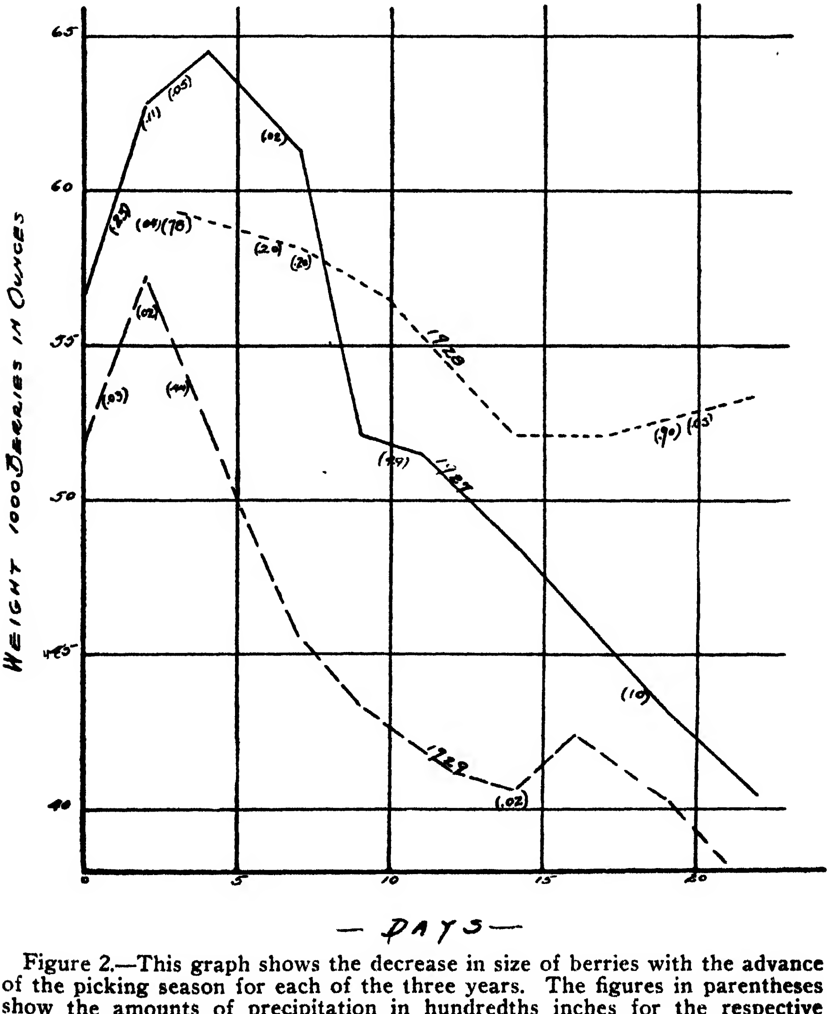

Figure 2.—This graph shows the decrease in size of berries with the advance of the picking season for each of the three years. The figures in parentheses show the amounts of precipitation in hundredths inches for the respective days of each season.

fresh fruit basis (cost of fertilizer deducted) for the treatments in the order in which they appear in Table 3 were $248.92, $228.01, $236.80, $233.61, $258.10, $232.31, and $222.51. The lower average returns on a fresh fruit basis, as compared to those calculated on a canning factory basis (Table 2), are due to the fact that the latter were figured on a basis of 8 cents a pound for the entire season of 1928, whereas mid and late season berries were not accepted at the canning factory and actually gave the grower a net return of less than 3 cents a pound on the fresh fruit basis.

It may be concluded, however, that nitrogen in a quickly available form applied about September 10 to 15 will result in materially increased early season yields of black raspberries and that some increases will also result from those applications made about August 1 or about the time that growth starts in the spring.

Size of Berries

Figure 2 shows that there is some increase in size of berries from the first to the second picking when the largest berries of the season are harvested. After the first quarter or third of the picking season, the berries become materially smaller with successive pickings. The large size of the early season berries is undoubtedly one of the important factors accounting for the better early season prices on the fresh fruit market.

The more horizontal trend of the line for 1928 in Figure 2 may be accounted for by the previously mentioned heavier rainfall for that year. Rainfall figures for the picking season are shown in parentheses in the graph. It may be noted that rains occuring during the latter part of the harvest seasons tended to maintain or even increase the size of the berries, and data not presented here show that such rains also tended to increase yields of the succeeding one or two pickings.

The average annual size of berries produced by the unfertilized plants was slightly greater than that for any other treatment, but the average differences in size of fruits between treatments was of little, if any, significance.

Discussion

It must not be inferred that the results reported from this experiment could be duplicated in the average Michigan black raspberry field. The yield data indicate that this field must be regarded as exceptionally good, rather than a representative one. The question, "does it pay to apply commercial fertilizers to raspberry plantations?" can only be answered in part at present. We know that such fertilizers as sulphate of ammonia or nitrate of soda applied about mid-September, or even in the spring or in early August, should result in a heavier early season production of fruit. We also know that, from the standpoint of total season production, it probably will not pay to fertilize plants that are rather vigorous, as indicated by average annual yields of approximately 150 16-quart crates per acre or about one and one-half tons. Neither is the size of berries likely to be influenced materially under such conditions. However, we still do not know whether total season yields of healthy plants that are producing only moderate yields, that is 50 to 100 crates per acre, can be materially increased by applications of nitrogenous fertilizers. When it seems desirable for the grower to make tests in his own field, and this should be encouraged, it is suggested that the fertilizer be applied in mid-September.

SMALL SEED PIECES REDUCE POTATO YIELDS

Use of Proper Sizes Also Improves Quality by Reducing Hollow Heart in Wet Years

E. J. WHEELER, FARM CROP SECTION

Tests comparing the sizes of potato seed pieces were conducted in 1928 and 1929. These tests were a continuation of the experiment reported in the Quarterly Bulletin, August, 1928, Vol. XI, No. 1. In 1928 the experiments were conducted at Rossman Brothers Farm, Lakeview; W. K. Kellogg Farm, Augusta; and at the Michigan State College Experiment Station. In 1929, the experiment was conducted at the W. K. Kellogg Farm and Michigan State College Experiment Station.

One-half ounce, one ounce, one and one-half ounce, and two ounce seed pieces were planted in separate plots in hills 36 x 36 inches apart. Certified Russet Rural potatoes uniform in size were selected for the experiment. The plots were replicated three times.

Results of the tests are given in the accompanying table.

Results of size of seed piece tests, 1928 and 1929

Year	Size of seed piece, ounces	Average yield per acre, bushels	Average per cent hollow heart
1928	One-half	126 58	11 59
	One	138 25	9 72
	One and one-half	169 46	5 75
	Two	164 33	4 97
1929	One-half	56 32	0 00
	One	79 23	0 00
	One and one-half	82 48	0 00
	Two	92 48	0 00

In the 1928 tests, the one and one-half ounce sets yielded 42.88 bushels more per acre than the one-half ounce seed pieces. The amount of hollow heart was 5.84 per cent higher in the one-half ounce than in the one and one-half ounce sets. The difference in hollow heart between the one and one-half ounce and two ounce seed pieces was only .78 per cent. The 1928 results show that as the size or weight of the seed piece is increased the yield is increased, except in the case where the two ounce seed piece yielded 5.13 bushels less than the one and one-half ounce seed pieces. This difference, however, is not significant. As the size of the seed piece was increased the per cent of hollow heart was decreased. There were 6.6 per cent more hollow heart potatoes by weight in the crop grown from

one-half ounce seed pieces than in the crop from the two ounce sets.

The 1929 results on the effect of size of seed piece on yield are compared to those of 1928. The two ounce seed pieces yielded 36.16 more bushels per acre than the one-half ounce seed pieces. There was insufficient moisture during the growing season in 1929 to cause hollow heart. In 1928, there was sufficient rainfall to cause considerable hollow heart.

The two years' results would indicate that as the size of the potato seed piece is increased from one-half to two ounces the yield is increased. Furthermore, large seed pieces are a factor in reducing hollow heart in wet seasons that favor its development.

It is recommended that growers cut seed potatoes one and one-half to two ounces in weight. The pieces should be cut square or blocky so that they will handle well in the planter and will not be so likely to rot or dry out in the soil. Thin, long seed pieces often cause clogging of the planting machine and they may rot in the soil before the plant establishes a strong root system. Approximately 15 bushels of seed cut to one and one-half ounce pieces will plant an acre, when the rows are 36 inches apart and the hills are spaced 18 inches apart in the row.

REQUIREMENTS OF FOREST TREES DIFFER

Soil, Moisture, and Light are Factors Determining Life or Death for Certain Species

R. H. WESTVELD, FORESTRY SECTION

Trees differ in their requirements in the same way that farm crops do. Some trees will grow on poor soil while others require a relatively fertile soil. It is well known that the conifers, particularly the pines, grow well on light sandy soils whereas the hardwoods require loamy or clay soils. Not only do trees differ in their soil requirements but they also have preferences regarding light and moisture. The ability to endure adverse light, moisture and physical conditions is often referred to as the tolerance of a species. The degree to which a tree can reproduce, develop, and grow in competition with other trees determines its degree of tolerance. An understanding of the relative tolerance of a tree is helpful in the proper handling of a woodlot because the extent to which a stand should be opened up by cutting depends upon how much relief from competition the different species require.

Virgin Stands Reveal Significant Facts

Virgin stands, which are the result of generations of development, are valuable indicators of the adaptability of trees to their environment. They show what conditions are unfavorable for the growth of certain species, thus demonstrating indirectly what conditions might be favorable for their

development. As one way of learning more about the requirements of the native species of Michigan under forest conditions, the Forestry Department is studying conditions in virgin forests. Such forests in the lower peninsula of Michigan are rapidly disappearing but, fortunately, there are a few tracts, such as the Newton woods in Cass county, which is the basis for the present study, that have escaped much disturbance by the axe or fire.

The Newton woods is characteristic of the type of forest which originally occupied the better classes of soil in the extreme southern part of the State. Here such species as the black walnut, tulip poplar, American elm, white oak, and white ash reach excellent development, trees three and four feet in diameter and more than a hundred feet in height are common, with an occasional tree five and six feet in diameter and 125 to 150 feet tall. Several other species grow in mixture (as shown by the tabulation) but are not conspicuous because of their smaller size. Aside from the large size of the trees and the relatively virgin character, the casual observer would note nothing unusual about the forest. A careful study, however, brings out some interesting facts.

In any forest which is more or less uneven aged, the trees occur somewhat in layers, the small reproduction forming a sort of ground cover, the larger reproduction and saplings forming a little higher layer. Above these two layers is usually found another layer, not sharply defined into two layers, which is made up primarily of the older trees. Each of these layers of trees is growing under different conditions of light, moisture and competition, the conditions becoming more favorable progressively from the lower to the upper layers. The extent to which the various species in a forest occur naturally in each of these layers is a good index of the requirements of a species as to light, moisture, and competition which can be made use of in handling woodlots.

These different layers given in the example which follows will be referred to as small reproduction, large reproduction and saplings, intermediate, and dominant trees. A survey of an uncut portion of the Newton woods showed the following condition:

Table 1.—The Per Cent of Each Species Occurring in Each Layer of the Forest

Species	Dominant	Intermediate	Large reproduction saplings	Small reproduction
	Per cent of total number of trees in each layer			
Tulip poplar	9 4	5 4	0 0	0 0
Black Walnut	32 1	0 5	0 0	0 0
White ash	5 7	2 8	0 0	0 0
Black cherry	3 8	0 0	0 0	2 3
Red oak	3 8	1 6	6 8	0 8
White oak	20 7	1 1	0 0	1 5
Beech	7 5	10 3	0 0	1 5
Elm	3 8	10 9	20 5	58 0
Sugar maple	13 2	60 9	65 9	22 1
Red maple	0 0	1 1	2 3	3 1
Ironwood	0 0	4 9	0 0	0 0
Blue beech	0 0	0 5	0 0	0 0
Service berry	0 0	0 0	4.5	6 8
Paw Paw	0 0	0 0	0 0	3 1

It is interesting to note that the so-called weed species, red maple, ironwood, blue beech, serviceberry, and paw paw are not at all conspicuous in

the stand, never getting into the dominant layer and occurring only in small numbers in the lower layers. These species, therefore, in a stand of this character are eliminated from the main stand by natural means. The important species can be divided into three groups based on their ability to develop under all conditions. Tulip poplar, black walnut, white ash, and black cherry constitute a group of trees which find difficulty in maintaining themselves in a closed stand, as is indicated by their almost entire absence in the two lower layers of the forest. Apparently, these species become established only when open conditions exist. Another group represented by red oak and white oak is less exacting in its requirements, occurring to a limited extent under all conditions of competitoin. Beech, sugar maple, and elm, particularly the last two species whic' form the third group are very prominent in all parts of the stand, evidencing their keen competitive ability.

Practical Value of Facts Established in Virgin Forests

Evidence points to the fact that even a virgin forest is not a stable thing, that the proportion of different species found in a stand is gradually changing, and that the more tolerant species, which have the most competitive ability, have a tendency gradually to increase their numbers at the expense of the less tolerant or intolerant species. In managing a woodlot, it is important to consider the trends of these changes and the requirements of each species. If trees such as tulip poplar, black walnut, white ash, and black cherry are to be favored, cutting should be relatively heavy to reduce the competition. For red oak and white oak, the cutting could be somewhat lighter and for the tolerant beech, elm, and sugar maple the cutting could be still lighter, without hindering the establishment and development of young growth.

Applied to planting of these species, it means that the less tolerant species must be spaced more widely than the more tolerant species.

The Forestry Department is interested in finding other virgin forests for study in southern Michigan and any information regarding the location of such stands will be appreciated.

ALL DOMESTIC FOWL CONTRACT BRUCELLA DISEASE

Turkey, Pigeon, Pheasant, Duck, and Goose are Susceptible in Trials Conducted at College

M. W. EMMEL, BACTERIOLOGICAL SECTION

A previous issue of the quarterly contained a summary of a group of experiments in which it was shown for the first time that chickens are susceptible to infection by a group of organisms causing abortion disease in cattle and hogs, malta fever in the goat, and undulant fever in the human. Since the conclusion of these experiments, numerous cases of natural infection have been found. These cases have occurred principally on farms where birds are allowed to follow infected cattle and hogs or where the infected products of such animals may be consumed by birds. However, the disease has been found in one commercial flock in which the source of infection was undetermined, although a complete history of the flock was available.

A group of experiments have just been completed to determine the susceptibility of the turkey, pigeon, pheasant, duck, and goose to infection by the organisms of the genus *Brucella*. As far as can be ascertained the literature does not contain any work to show that these birds are susceptible to this infection. One strain of each species was used—*Brucella abortus*, *Brucella suis*, and *Brucella melitensis*. These particular strains were used with no knowledge of their pathogenicity for chickens or other animals.

The results obtained in these experiments force the conclusion that all of these birds appear susceptible to infection by organisms of this group when fed massive doses. The rate of mortality, however, was not nearly so high as in the fowl.

The disease produced in turkeys more closely resembles that produced in the fowl. Gradual emaciation and paleness about the head were the characteristic symptoms produced in the turkey. The disease extends over a long period of time, 3 to 4 months. Mortality was much higher than in any of the other birds.

The disease produced in the pigeon and pheasant was very similar. Mortality was low in each instance, although some of these birds' blood sera showed at some time during the course of the experiments an agglutination titer of 1 to 500. Very few of these birds showed symptoms of infection. Several of the pigeons showed somewhat ruffled feathers at the peak of the agglutination titer. Though it has not been definitely proved that naturally infected birds eliminate the causative organisms in their droppings, the fact should not be overlooked that pigeons and pheasants may prove to be a means by which the abortion organisms are spread. It is not uncommon for these birds to feed in farm lots which may harbor infected animals and they could very easily become carriers of the infection.

Ducks and geese acted very similar in their susceptibility to the infection. All of these birds become infected as indicated by a microscopic examination of their tissues. However, there seemed to be a marked variation in the ability of these birds' blood sera to produce specific agglutinins. Many birds remained negative to the agglutination test even though they were later proved to be infected. None of these birds showed symptoms of disease except for a slight increase in respiration. None of these birds died.

Suitable controls were kept during the course of the experiments. The agglutination titer of these birds blood sera remained negative and their tissues showed no lesions upon microscopic examination.

Gross lesions of such a character that the disease can be fairly accuratelv diagnosed were produced in the chicken. Howev.r, in the case of the birds in this group of experiments it is very difficult to diagnose the disease upon the gross lesions produced. The microscopic lesions produced in all of these birds were essentially the same in character as those previously produced in the fowl when infected by the same organisms.

The agglutination test applied to the flock should give a fairly accurate indication as to whether infection is present. As very few symptoms are produced in the pheasant, pigeon, duck, and goose, it is thought that the disease may often go unnoticed in these birds.

PURE WATER IS ESSENTIAL TO HEALTH

Purification of Water Supplies Has Greatly Lowered the Number of Deaths from Typhoid Fever

W. L. MALLMANN, BACTERIOLOGICAL SECTION

A pure water supply is one of man's greatest assets in maintaining health. Too frequently, however, he does not interest himself in ascertaining whether or not he does have pure water. A well that yields abundantly a clear cool water, irrespective of the type or condition, is assumed without question to be pure. It is an accepted axiom that clear cool water is pure water. Unfortunately, freedom from suspended particles and degrees of temperature have little to do with the sanitary quality of a water supply. Only the bacteriologist in his laboratory is qualified to pass accurate judgment as to its sanitary quality.

To demonstrate the relation of pure water to health, it is only necessary to scan the vital statistics of any state and to note death rates before the use of purified water by our large cities and death rates after purification. The death rates of a disease, for example, typhoid fever, which is the most common water-borne disease, show marked reductions. In 1900, before the introduction of purified water, this state had a typhoid death rate of 37 deaths per 100,000 population. In 1908, the first filtration plant was installed at Grand Rapids and this was rapidly followed by others; later, the water

was treated chemically with chlorine to destroy bacteria. Each year an increasing proportion of the urban population was supplied with pure water. As this gradual but increasingly rapid change from unsafe to safe water was occurring, an equally gradual but rapidly decreasing death rate occurred, until, in 1928, the typhoid death rate for the entire state was 1.8 deaths per 100,000 people. Today, in Michigan, practically every city or village of any appreciable size has pure water. Impure water is now strictly a rural problem. Typhoid fever, if water-borne, is contracted from rural supplies.

Beside the reduction of water-borne disease by drinking pure water, it has also been observed that people using pure water have lower death rates from diseases not water-borne. Figures obtained from cities before and after the installation of pure supplies show, as computed mathematically by a prominent sanitary engineer that, "where one death from typhoid fever is avoided by drinking a pure water, three or four deaths from other causes are also avoided." These facts emphasize the need of pure water. Unfortunately, it is impossible to evaluate statistically the relation of rural water supplies to disease incidence, but it seems quite unnecessary as the figures obtained in our large urban communities tell a true story which applies equally well to rural conditions.

For the past 15 years, the Bacteriological Department of the college has made a study of rural water supplies. From time to time, rural dwellers have been urged to improve their water supplies by submitting samples to this department for examination to determine the purity of their supplies and to obtain aid in correcting faulty wells. The writer has observed considerable improvement. Ten years ago, 33 per cent of all samples submitted to this laboratory were reported as unsafe while last year only 20 per cent were thus reported. However, there are many wells which need improvements.

Whether a well is polluted or not is determined very largely by the type of well, its location and its physical condition. A brief discussion of the different types of water supplies, with their advantages and disadvantages follows:

Rivers and Lakes

The amount of pollution in lakes and rivers is dependent entirely upon the amount of sewage entering them. A stream passing through a populated area is invariably an unsafe source of water. There are so few streams and lakes in this state that are free from pollution that one may safely generalize and state that all lakes and rivers in this state are unsatisfactory sources of drinking water unless treated.

Springs

There are three types of springs: surface, hillside, and underground. Generally, these types as they emerge from the ground are safe water supplies. However, the method of collecting the water is usually unsatisfactory, and a polluted water results. Any open reservoir type of collection is undesirable and generally shows pollution on bacteriological examination. If properly collected, these same supplies are very desirable. The best method of collecting is to drive a pipe or a series of pipes back into the ground at the source of the spring and convey the water through these pipes into a closed concrete reservoir from which the water pours

by gravity from an outflow pipe. This method avoids surface contamination at the point of collection and generally yields a good water supply. Hillside springs should be regarded with suspicion unless the high ground is uninhabited by man or animal. Privies in the water-bearing area should condemn such supplies as dangerous.

Dug Wells

The dug well should be a thing of the past. The old oaken bucket is beautiful in song but in practice is very dangerous. Only two or three such well have been found safe out of a large number examined. An improperly constructed dug well allows pollution to enter through the open or planked top and allows surface water to enter the well cistern without sufficient filtration through the soil. It is not infrequent to find dead animals in such wells.

An ideal dug well should be a safe supply. If the following suggestions are observed, a safe water should result. The sides of the well cistern should be impervious to water, forcing the entering water to travel down through the soil to the bottom of the cistern before entering the well. This insures filtration of the water through the maximum amount of soil. The curb should be well above the surface of the ground to prevent flood waters entering at the top. The top should be sealed with a concrete cover with a life pump sealed in securely. A cylinder type pump should be used. The well should be at least 18 feet deep. Waste water from the well should be carried away by a properly constructed drain. Stock water tanks should be placed at a distance of at least 75 or 100 feet from the well. Privies should also be at least 75 to 100 feet away. The slope of the ground should be away from the well and under no circumstances toward the well. The water should be examined regularly once a year.

Driven Wells

Driven wells obtain their supply of water from the same stratum of earth as dug wells. Rules for the installation of this type of well are, for this reason, the same as for dug wells. Driven wells, however, are generally properly constructed and hence most, 80 per cent, of them are safe water supplies. They should be examined bacteriologically once a year.

Deep Wells

Deep wells are drilled wells that, in most cases, reach into bed-rock. These wells are the best sources of water known. Water entering such wells comes from beneath the rock and is free from surface water. The water is practically bacteria-free. If such wells are properly constructed with tight connections at all joints, proper frost pits, and tight gaskets in valves, the water is, with few exceptions, safe.

For the benefit of rural dwellers who desire to ascertain purity of their water, directions for the proper collection of samples are reprinted. Also a questionnaire to be filled out and returned with the sample is appended. No charge by the bacteriology department is made for a sanitary analysis.

THE METHOD OF COLLECTING WATER SAMPLES FOR BACTERIOLOGICAL EXAMINATION

The collection of a water sample should, if possible, be performed by a person trained in bacteriology. A great deal of care must be exercised in collecting in order to prevent outside contamination entering the sample. The most important precautions to be observed are: (1) the sample bottle and stopper must be prepared as described below, (2) the sample collected should be representative of the supply, (3) nothing should come in contact with parts of bottle that will come in contact with the water, and (4) the sample should be shipped immediately after collection.

Sample Bottle

The best container available in most homes is a pint Mason fruit jar. A new cover and new rubber should always be used and, if possible, a new jar. Wash thoroughly and rinse in boiling water.

Preparation of the Sample Bottle

The best method of preparation is boiling. Place the jar, with the rubber attached, and the cover in a pan of hot water. Boil vigorously for at least 30 minutes.

Removal of Bottle from Boiling Water

Remove the bottle from the water bottom side uppermost. Secure the cover by the outside only.

Collecting the Sample

If the water supply is from a well, pump the well for about fifteen minutes before taking the sample; if from a tap, allow the water to run for half an hour; and if from a stream or still body of water, plunge the jar down beneath the surface of the water and keep moving up-stream or forward while filling. This prevents the water which comes in contact with the hand from entering the jar. Collect the water directly into the jar, prepared as described above, filling the jar about three-quarters full. Seal at once. *Be sure than nothing comes in contact with the parts of the bottle that come in contact with the water.*

Shipping

Pack well, using ice if possible, and ship at once by parcel post or express. When possible ship the sample during the early part of the week so the sample will reach the laboratory before Saturday. *All samples should be shipped immediately after collecting.*

History

The questionnaire which accompanies this sheet should be filled out completely and mailed with the sample.

Department of Bacteriology,
Michigan State College,
East Lansing, Michigan.

WATER QUESTIONNAIRE

NOTE:—*This sheet must be filled out as completely as possible and returned to us before we can send you a report on sample submitted, as this information is necessary in passing judgment on your supply.*

Name................ Date of shipping ....19.... (a. m., p. m.)

Address .... Date received ....19.... (a. m., p. m.)

Source of sample:

Lake; river; dug, driven, or drilled well; spring ....

Lakes or rivers: Does sewage or other water empty into the water? ....

Describe condition fully................

....

Wells: Describe type of well................

Depth................ Kind of soil ....

Depth to bed-rock .... Kind of subsoil ....

Slope of land relative to well ....

Kind of pump................ Kind of platform ....

Do you prime the pump? ....

Are walls and top water-tight?................

Is frost-pit dry?................ Do you have drain for waste water?

Is there air in the water when pumped? ....

Distance of well from surrounding objects:

House................ Manure piles or other refuse ....

Barn................Dumping grounds for kitchen slop ....

Privy................ (Type)................ Pig pens................

Springs: Open reservoir................Closed reservoir................

Describe surroundings................

Do you have a water system?................ Pressure or gravity................

Location of storage tank................

Why do you think the water is polluted?................

Has the well given any trouble before?................

What was the nature of the trouble? ....

Has the water been tested before?................ Report?................

Remarks:................

....

MOLE DRAINAGE TESTED IN MICHIGAN SOILS

Trials Indicate Principal Value of System Is In Combination With Tile Drains

O. E. ROBEY, AGRICULTURAL ENGINEERING

A study of agricultural literature of the last one hundred years reveals the fact that mole drainage is by no means a new practice. It dates back at least to the beginning of the last century. In fact, in England on December 9, 1795, a Mr. Weston wrote, "With respect to the mole plow, I really think too much cannot be said in its commendation for the purpose of temporary drainage."

Fig. 1.—The mole plow, with coulter and the mole which shapes the drain.

About 1855, we find references to a Major Dickinson of New York having used this type of drainage and apparently it had been in use for some time on his farm, as a writer in the New York Tribune states, "From ten to twenty acres per day are thus drained and Major Dickinson has such drains of fifteen to twenty years standing, which still do good service."

At later periods this method of drainage was used in Illinois, Iowa and other western states.

During the spring of 1927, the Agricultural Engineering Department of Michigan State College started some experiments to determine the practicability of mole drainage on certain Michigan soil types, especially the Ontonagon clays of the upper peninsula.

"The essential feature of this system of draining is the use of a cartridge-

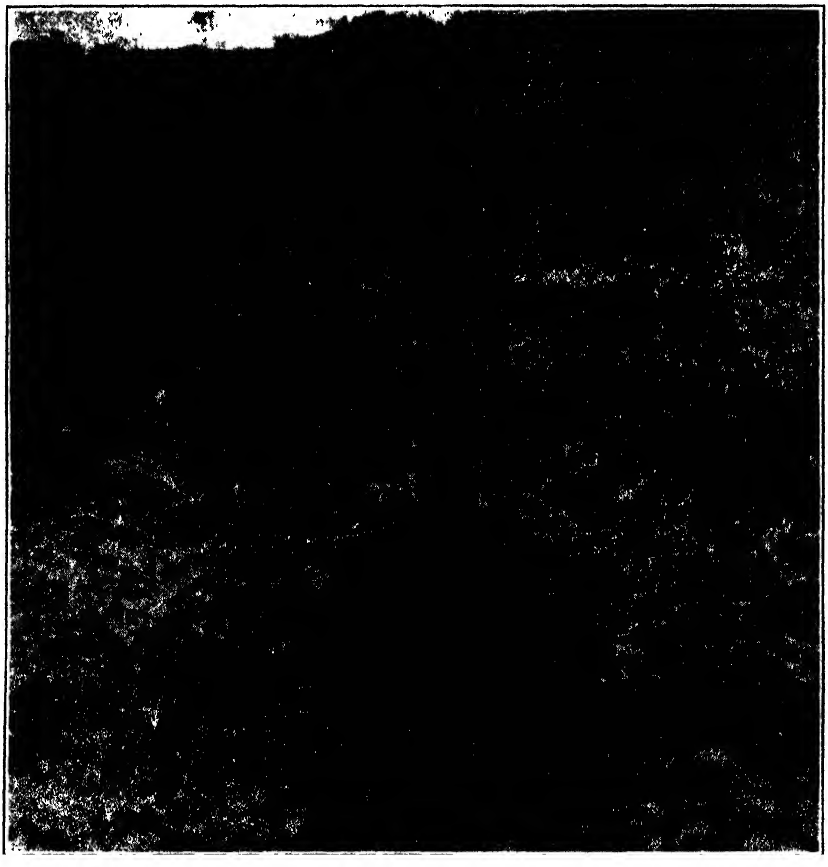

Fig. 2.—Cross section in soil showing the drain and the slit left by the mole plow.

shaped piece of steel which is drawn through the sub-soil at the end of a strong coulter and which, by compressing the soil in its passage, leaves a channel whereby the water can escape. The narrow slit cut by the coulter soon closes up and the water passes into the mole drain by percolation. The mole drains have outlets either into a main drain or an open ditch. It is clear that mole drains will only be of value in certain types of soil which are plastic. In practice, mole draining is restricted to clayey sub-soils and

the life of the drains will depend to some extent on the character of the clay."*

One of the Michigan tests was carried out on the Osborn farm in Chippewa county in 1927. This was a plot of about eighteen acres of slightly rolling clay ground. The mole openings were of four and six inch sizes and put in about two feet deep. The mole lines were spaced two rods apart with a few one rod apart. It required a ten-ton track-laying tractor to haul the mole plow. The soil was quite moist; the mole, when it passed through the soil, left a very smooth surface on the wall of the opening. Both soil and moisture conditions seemed to be favorable for this type of drainage.

The mole drains were examined at various times during the summer and fall of 1927 and also the spring and fall of 1928. In the fall of 1927, a number of the drains were still open and seemed to be carrying some water. Many of them, however, were partially or completely closed. The next spring practically all were closed or filled with soft mud, although in this condition they seemed to carry some water. Test wells were put in between the tile lines to study the water table. Observations made did not indicate that the mole lines were having much effect in lowering the water table.

It might be said, however, that at the same time two lines of four-inch tile were put in on the same plot to serve as checks. These tile lines were put in parallel to the mole lines and spaced four rods apart. Test wells were also put in to study the effect of the tile on the water table but there was practically no effect noticeable on the water table except about six feet away from the tile. The clay was so dense that it did not respond to drainage. Later observations after three years, show that the tile lines are still ineffective except immediately above the tile lines.

Other plots have been put in Arenac, St. Clair, Huron, and Shiawassee counties and also on the Selfridge Field airport, with perhaps less promising results than those already described. Some of these trial plots were subjected to abnormal conditions of rainfall such as have been experienced in the last two or three seasons. Two of them, as soon as completed and before the slit above the mole had become closed, were subjected to a very severe rain which broke down a great many of the moles before they became established.

Though the results so far observed from the mole drainage test plots seem to indicate that mole drains are not very durable, yet it would seem that there may be a place for this type of drainage in combination with tile or open ditches. By putting in tile lines at intervals of 8 to 20 rods and cross hatching these with mole lines, the water would be materially assisted in flowing toward the tile. The same scheme might be used to hasten the drainage on more intensively drained land that is too dense to drain readily. Putting in the moles should have the effect of breaking up the hardpan and establishing new lanes for the drainage water to follow.

The operation of moling is comparatively cheap, probably not costing more than two dollars per acre when the lines are spaced two rods apart. This operation could be repeated when needed. This combination would greatly reduce the initial cost of drainage on some types of clay land.

*Leaflet No. 356—Ministry of Agriculture and Fisheries, England.

HONEY MAY BE USED IN ICE CREAM

Makes a New Popular Flavoring or Can Be Utilized to Coat Bars

P. S. LUCAS, DAIRY SECTION

Honey makes a delightful flavoring material for ice cream. During the war, it was used as a sugar substitute but under present conditions, due to the low cost of sugar per unit of sweetening value, it is not used primarily for that purpose. Not only may honey be used in the production of honey-flavored ice cream but it may be used in preparing a coating for bars of ice cream, similar to the chocolate-coated bars. Formulae have been worked out at the Michigan Experiment Station with different types of honey and in different proportions using cocoa butter and cocoanut butter as the vehicle for carrying the honey.

Honey has long been recognized as a desirable food. Today, there are in Michigan over 200,000 colonies of bees, whose crop totals approximately 15,000,000 pounds of honey annually. More than a score of Michigan bee-keepers produce honey in carload lots, and the product may now be obtained in large quanities of uniform grade, color, and flavor at any time of year. Increasing production has resulted in the problem of marketing becoming more important and often more difficult, and bee keepers generally are much interested in possible new outlets for their product. One of these is for the sweetening and flavoring of ice cream.

In tests made at this Station several years ago, honey was found to supply about 57.4 per cent of the sweetness of sucrose, measured pound for pound. Calculated in terms of sucrose it would require therefore approximately 1.74 pounds of honey to replace one pound of sugar. If honey costs 10 cents per pound and sugar 6 cents, it would cost, if honey were used as the sole sweetener for ice cream, 17.4 cents to secure the same sweetening value as is supplied by a pound of sugar. However, this sweetening value is difficult to ascertain due to the peculiar piercing sweetness of levulose, one of the two sugars found in honey.

The most satisfactory recipe thus far employed is the following (the quantities and prices given being those required for 10 gallons of finished ice cream:

40	pounds 17 per cent cream at 70c per pound fat.........	$4.76
11	pounds extracted honey at 10c per pound..............	1.10
4	ounces gelatin at 56c per pound	.14
	Color, lemon yellow	.05
		$6.05

The mix is thus seen to cost approximately 60 cents per gallon. It will test 13.3 per cent butterfat, and 37.1 per cent total solids, figuring honey

at 81.56 per cent total solids. This cost compares favorably with that of mixes prepared from the usual components, testing similarly, and considering that no other flavoring material should be used. It is processed in the usual manner and handled similar to other mixes during the freezing process, making allowance for the lowered freezing point caused by the honey.

Aside from its food value, honey in ice cream supplies a distinctive flavor and one that apparently is destined to prove popular. If used to replace sugar only in part, much of the flavor is masked by that of the dairy products in the mix. For the past few years, this type of ice cream has been made by the dairy section of the Michigan Agricultural Experiment Station at times when large groups of people have been on the campus. Its popularity has been amply approved in these trials.

Honey-Coated Ice Cream Bars

Among the many flavored coatings used for ice cream bars no mention has been found in the literature of the use of honey, although it will supply an appetizing coating of attractive appearance. A satisfactory coating must not be sticky and must solidify in a relatively short time after dipping. Of primary importance is the use of a vehicle free from objectionable taste. The base commonly used is high grade coco butter or cocoanut butter or a combination of both. These materials owe their particular value to their high congealing point.

In seeking a formula combining these qualities, five mixtures were made up. The first contained equal parts of coco butter, cocoanut butter, and white clover honey. The two butters were first melted, mixed together, and the honey added. This mixture was held at its lowest melting point and the ice cream bars dipped. The result was unsatisfactory, the coating being slightly scaly. The second contained two parts of coco butter, two parts of white clover honey, and one part of powdered sugar. This too was unsatisfactory, being too sweet, "grainy," and contained insufficient honey flavor. Another mixture contained equal parts of coco butter and white clover honey. This proved to be satisfactory, possessing sufficient flavor, coating well, and having a very desirable color. A fourth mixture was made up of equal parts of coco butter and buckwheat honey. As is well known, buckwheat honey has a caramel color, and this persists even when diluted with the colorless coco butter. This type of honey assumes a slightly different flavor, however, when thus diluted and yields a satisfactory coating, although it is believed that this type of coating will never be so popular as those which will give a lighter color.

The most popular of the mixtures proved to be one made up of equal parts of coco butter and basswood honey. The color was excellent and the flavor best of the three types of honey used.

Probably the recipes mentioned for coatings are satisfactory only for hand dipping because of the length of time required for the coating to solidify. This is apparently necessary because it is essential that sufficient honey be used to impart a distinct honey flavor. It is believed this new type of coating may supply in part the constant demand for the unusual as well as provide another wholesome product attractive in appearance.

MICHIGAN HENS HAVE GOOD RATING IN CONTEST

Records Show Steady Increase in Production for Birds from Trapnested Breeding Stock

E. S. WEISNER, POULTRY SECTION

Previous to the beginning of the first Michigan International Egg Laying Contest, in November, 1922, few Michigan breeders had been entering birds in the contests in other states and the records from so few birds were not sufficient to furnish much evidence of the egg producing power of stock raised in this state. Records were being kept by some of the better established breeders but they were not officially supervised and did not greatly impress prospective purchasers of breeding stock. The reason for starting the Michigan contest was to provide a place where poultrymen could have part of their flocks officially trapnested. The trapnested hens which made satisfactory records furnished a foundation for an intelligent breeding program for flock improvement.

After the completion of seven contest years, the data appears ample to warrant a comparison between stock raised by Michigan poultrymen and that produced in other states. In this connection, it should be noted that many of the Michigan hens were entered from farm flocks of the better class but where little or no systematic breeding work had been done. A few breeders had been trapnesting their own hens and following an intelligent breeding practice, but representatives from these flocks constituted a small portion of the Michigan-owned entries.

Data for the seven years are summarized in tables 1 to 3, where the production records are grouped according to year, breed, and sources of stock.

Seventy per cent of the 8,700 birds entered in the seven Michigan contests were from this state. In competition with them, were birds from the flocks of many of the best breeders in the country. Over the seven-year period, the birds from out of the state have averaged a little less than one egg more per year than the Michigan birds. The 6,115 Michigan hens have averaged 183.6, while the 2,585 out-of-state hens produced 184.3 eggs per hen.

One of the most significant points brought out by the contest is shown clearly in Table 2 which gives the average annual production per hen. In spite of considerable fluctuations from season to season, there is noted a distinct increase in productivity as the contest has progressed. How much of this is to be attributed to the influence of this and other egg laying contests, in placing a premium on stock of known productivity, and how much to other educational agencies, it is impossible to say. It is plain, nevertheless, that the stocks of the poultry breeders are showing improvement in egg production and this fact, coupled with the modern tendency of demanding stock of known origin and productivity is certain to exert considerable influence on future egg production.

Table 1.—Number of birds of the various breeds in seven contest years

	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	1928 1929	Total from Mich.	Total from out of state	Total birds of each breed entered
Barred Rocks	216	264	204	204	195	195	260	1169	369	1,538
White Rocks	12	12	12	0	13	0	39	88	0	88
Buff Rocks	12	0	0	12	0	0	0	24	0	24
Col. Rocks	0	0	0	12	0	0	0	12	0	12
Dominique	0	12	0	0	0	0	0		12	12
White Wyandotte	108	60	36	0	13	0	0	181	36	217
Buff Wyandotte	12	12	0	12	0	0	0	36	0	36
S. C. R. I. Red	60	84	120	144	234	156	91	521	368	889
R. C. R. I. Red	12	12	12	12	13	39	26	126	0	126
Black Orp	12	0	0	0	0	0	0	12	0	12
Barnvelders	0	0	0	12	0	0	0	0	12	12
Black Minorcas	12	12	0	0	0	0	0	12	12	24
Anconas	84	84	36	36	39	26	0	255	50	305
R. C. Br. Leg	0	12	0	0	0	0	0	12	0	12
S. C. Br. Leg	24	12	12	12	13	13	13	99	0	99
Buff Leghorns	12	0	12	12	0	26	13	75	0	75
White Leghorns	624	624	756	732	780	845	858	3,493	1,726	5,219
Totals	1,200	1,200	1,200	1,200	1,300	1,300	1,300	6,115	1,726	8,700
Percentages								70 3	29 7	

Table 2.—Average annual production per hen for the seven year period for all breeds from all sources, figured on the basis of 1000 birds

Breed	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	1928 1929	Average for breed over 7 years
Plymouth Rocks	142 0	154 4	152 4	177 7	176 0	179 5	184 7	166 8
R I Reds	135 2	162 8	159 7	150 2	173 0	185 4	191 6	165 4
Wyandottes	125 1	133 4	164 3	144 8	163 3	*	*	147 2
Anconas	*	170 0	146 0	152 1	153 1	167 6	*	157 9
Leghorns	157 0	174 6	183 5	206 3	212 9	201 0	221 2	194 4
All breeds	156 4	161 4	175 4	192 8	197 8	194 3	210 6	184 1

*None of breeds entered in contest that year.

Table 3.—The production per hen for all breeds from Michigan and for those from outside the state

Year	Average No eggs Mich. hens	Average No. eggs out-of-state-hens
1922-23	150 8	162 3
1923-24	162 1	158 1
1924-25	173 8	179 8
1925-26	193 1	192 6
1926-27	202 2	190 5
1927-28	196 6	189 8
1928-29	206 4	217 0
Average 7 years	183.6	184.3

BARLEY IS SATISFACTORY IN POULTRY RATION

Value of the Grain Is Compared With Corn in Experiments at College

BY J. M. MOORE, POULTRY S CTION

Many baby chick rations contain from 40 to 60 per cent of corn, and the growing and laying rations usually carry as high a percentage of it as of any one grain or milled by-product. Because of climatic limitations and the inroads of the corn borer in Michigan, it is important that some substitute should be found if the corn crop fails. Barley has been suggested as this substitute.

Poultry feeding experiments with barley were begun in November, 1928, at the Michigan Station. The aim has been to compare a simple ration which contained a relatively large proportion of barley and other ingredients easily obtained on the farm to what has come to be known as the standard M. S. C. ration which contains considerable corn.

Eighty S. C. Rhode Island Red pullets were carefully selected for each pen so that the age, weight, and laying ability of the birds in each were as nearly alike as possible. Electric lights were used in both pens. The lights were turned on in the morning at the proper time to give the birds an 12-hour day. In November and December, both pens contracted infectious bronchitis which accounts for the high mortality during those two months.

Pen 1 was fed a barley ration, Pen 3 was fed a corn ration, as follows:

MASH

Pen 1	Pen 3
40 lbs. ground wheat	30 lbs. yellow corn meal
30 lbs. fine ground barley	20 lbs. fine ground oats
10 lbs. alfalfa leaf meal	20 lbs. bran
10 lbs. meat scrap	20 lbs. flour middlings
3 lbs. steamed bone meal	10 lbs. alfalfa leaf meal
1 lb. salt	10 lbs. meat scrap
—	3 lbs. steamed bone meal
94 lbs.	1 lb. salt
	—
	114 lbs.

SCRATCH GRAIN

Pen 1	Pen 3
50 lbs. whole barley	50 lbs. cracked yellow corn
50 lbs. whole wheat	50 lbs. wheat
—	—
100 lbs.	100 lbs.

The mash was before the birds in open hoppers at all times. The ground barley used in Pen 1 and the ground oats used in Pen 3 were hammer-mill ground to a fineness such that no hull was discernible to the naked eye. The scratch grain was fed night and morning in the litter. The heaviest feeding was given at night.

Semi-solid buttermilk was fed to each pen once a day at noon. Cod liver oil was fed in the semi-solid buttermilk, starting December 1 and continuing through the hatching season, at the rate of 1 pound to 16 pounds of semi-solid. It was fed in the paste form on the walls of the pen in just the amount the birds would clean up in 30 minutes. Both pens were allowed an outside run whenever the weather permitted.

Oyster shell and water was provided ad libitum. Lettuce was fed once a day to both pens during winter and spring months until green succulent alfalfa was available.

The barley mash is slightly higher in protein than the corn mash but the birds in Pen 3 consumed 2.7 lbs. per bird more semi-solid buttermilk during the 10-month period than did those in Pen 1, showing their tendency to equalize the protein intake.

Data showing the mortality, feed consumption, egg production, income, and hatchability records are presented in Tables 1 to 5 inclusive, and a summary for the 10-month period is given in Table 6.

It will be noticed that the price of the barley mash fed in Pen 1 is 15 cents higher per hundred weight, than the corn mash fed in Pen 3. This is because the large amount of ground wheat in the barley mash was much higher in price than the ground oats, bran, and flour middlings in the mash fed in Pen 3. However, most of the ingredients of the mash ration used in Pen 1 are readily available on the average farm and do not require the cash outlay assumed here. The barley mash will therefore be more economical as a farm ration than the above figures might indicate.

During the months of June and July, the eggs from both pens were sold to a commercial egg dealer where the eggs from each pen were candled and graded separately. In comparing the quality of the eggs from the two pens, two differences were noted. The first was that the yolks from the barley-fed pen were a shade lighter in color than from the corn-fed pen. The

Table 1.—Mortality Record

Month	Pen 1	Pen 3
October	0	1
November	11	16
December	0	5
January	3	2
February	0	1
March	2	1
April	0	0
May	0	1
June	1	0
July	0	0
August	1	0
Total	18	27
Percentage	22 5	33 75

Table 2.—Feed Consumption Record

Month	Pen 1 (Barley Fed)				Pen 3 (Corn Fed)			
	Pounds scratch grain	Pounds mash	Pounds Semi-solid butter-milk	Pounds oyster shell	Pounds scratch grain	Pounds mash	Pounds Semi-solid butter-milk	Pounds oyster shell
November	139 0	222 0	130 0	8 0	279 0	181	117.0	7 5
December	268 5	210 0	111 0	30 0	249 0	171	102 5	22 5
January	393 5	100 0	109 0	20 0	395 0	92	105 5	20 0
February	355 0	97 5	98 5	20 0	245 0	79	91 0	20 0
March	365 0	148 0	108 0	20 0	261 0	95	100 0	10 0
April	300 0	163 5	73 5	15 0	161 5	131 75	67 0	10 0
May	338 0	182 5	74 0	15 0	269 0	136 75	63 5	10 0
June	349 0	56 0	63 5	16 0	245 0	100 5	62 5	10 0
July	344 5	92 5	58 5	15 0	268 0	100 5	49 5	10 0
August	255 5	78 5	55 0	15 0	273 0	58 5	48 0	10 0
Total	3,108 5	1,351 5	881 0	174 0	2,655 0	1,146 0	806 5	130 0
Price per cwt	$1 94	$2 65	$3 75	$1 00	$2 30	$2 50	$3 75	$1 00
Total cost	$60 30	$35 81	$33 04	$1 74	$61 07	$28 65	$30 24	$1 30

Table 3.—Egg Production

Month	Pen 1 (Barley Fed)			Pen 3 (Corn Fed)		
	No of hen days*	No of eggs produced	Percentage production	No of hen days*	No of eggs produced	Percentage production
November	2,287	395	17 3	2,113	266	12 6
December	2,139	864	40 4	1,927	769	39 9
January	2,107	970	46 0	1,756	955	54 4
February	1,868	931	49 9	1,543	774	50 2
March	2,010	1,053	52 3	1,689	943	55 8
April	1,920	1,042	54 3	1,620	951	58 7
May	1,984	1,134	57 2	1,646	902	54 7
June	1,901	948	49 9	1,590	871	54 8
July	1,953	913	47 2	1,643	829	50 5
August	1,951	878	45 0	1,643	765	46 6
*Total	20,120	9,128	Ave 45 4	17,170	8,025	Ave 47 4

	Pen 1	Pen 3
Average No of birds for period	66 2	56 5
No. of eggs per bird for period	138	144
Total feed cost	$130 89	$121.26
Cost per bird	$1 98	$2.15

*"Hen days" is the product obtained by multiplying the number of birds by the number of days of the trial.

Table 4.—Egg Receipts

Month	Pen 1 (Barley Fed)			Pen 3 (Corn Fed)		
	No of eggs	Average price per dozen	Egg receipts	No. of eggs	Average price per dozen	Egg receipts
November	395	51 7	$17 02	266	51 7	$11 46
December	864	55 0	39.60	769	55 0	35.25
January	970	43.1	34 84	955	43.1	34 30
February	931	41 0	31.81	774	41 0	26 45
March	1,053	38.4	33 70	943	38 4	27.18
April	1,042	30.5	20.48	951	30 5	24.17
May	1,134	30.0	28 35	902	30 0	22 55
June	948	34 2	27 02	871	34 2	24.82
July	913	35 0	27 63	829	35 0	24 18
August	878	42 1	30 80	765	42 1	26 84
Total	9,128		$297 25	8,025		$257 20
Total egg receipts per bird			$4 49			$4 55

Table 5.—Hatchability Record

Date set	Pen 1 (Barley Fed)			Pen 3 (Corn Fed)		
	No of eggs set	Infertiles	Healthy chicks	No of eggs set	Infertiles	Healthy chicks
March 20	78	4	50	97	18	42
March 27	92	9	62	149	25	58
April 4	197	15	138	177	22	123
April 11	132	6	100	112	12	58
April 18	144	12	103	155	25	119
April 27	266	37	164	208	27	107
Total	909	83	617	898	129	507
Percentage hatch of fertile eggs set			75 6			65 9

Table 6.—Summary for 10-month period

	Pen 1	Pen 3
No. of eggs produced per bird	138	144
Feed cost per bird	$1 98	$2.15
Feed cost per dozen eggs produced	$0 172	$0 181
Egg receipts per bird	$4 49	$4 55
Egg receipts per bird after deducting feed costs	$2 51	$2 40
Percentage hatch of fertile eggs set	75 6%	65.9%

second difference was that the shell texture of the eggs in the barley-fed pen was not as strong as those in the corn-fed pen. More eggs from Pen 1 were cracked in shipment than from Pen 3. It should be remembered that this report covers only one laying period and therefore the results obtained

do not warrant final conclusions. This study is being continued along the same general lines.

By way of summary it may nevertheless be said that the barley-fed pen compared very favorably with that fed the standard corn ration. The latter produced six more eggs per bird during the 10-month period but at a slightly greater cost per dozen. There were actually greater profits derived from feeding the barley ration as compared with that containing corn. This difference was small, probably not great enough to warrant a general recommendation to Michigan poultrymen to use barley in place of corn, especially since the data here recorded cover only a single laying period. The evidence indicates, however, that the one ration may be safely substituted for the other where corn cannot be grown advantageously or purchased at a reasonably low price and where conditions are favo able for barley production.

FERTILIZER AIDS ALFALFA ON SANDY SOIL

Best Results Obtained by Drilling Plant Food Before Seeding Crop

GEORGE M. GRANTHAM, SOILS SECTION

To obtain a good stand and then to promote a luxuriant growth are the two main objectives in alfalfa production. Success, however, cannot be expected unless reasonably favorable soil conditions are provided. Light soils in particular are likely to require treatments of one kind or another, since their supply of certain essential elements may be deficient for the best growth of crops.

Lime If Necessary

The growing of alfalfa on light soils usually, but not always, calls for liming the soil. It is always advisable to test the soil for lime requirement. If the soil is alkaline, there is no need for liming. If the soil is sour, apply sufficient lime to grow the crop. A few soils are extremely lime deficient and require from four to six tons of limestone per acre in order to grow alfalfa successfully; however, there are few soils in this group. The bulk of sour soils can be sufficiently supplied by applying from two to three tons of limestone per acre.

Fertilizing Is Profitable

Fertilizers are usually given but little consideration in growing alfalfa; however, on light soils, the use of fertilizer is almost as essential as limestone. Nitrogen applied alone or in a complete fertilizer seems to produce very little increase in yield on the poor phases of sandy soils. The average returns from 13 cuttings on a run-down Fox sandy soil in Kalamazoo county to which nitrogen had been applied were not enough greater than those from

Table 1.—Yields of Alfalfa on a Fox Sandy Loam in Cass County

Soil treatment	Pounds of dry hay per cutting* Average of 8 cuttings
Lime alone	1,308
Lime, phosphate and potash	1,948

*From one to three cuttings per year were made.

untreated plots to pay the cost of the material. Phosphate when applied alone usually increases yields; however, as a general rule, the results are not as striking as might be expected. Potash has usually proven effective in the fertilization of alfalfa on the lighter soils and, when mixed with phosphate, provides an excellent fertilizer combination for this crop. The beneficial effect of potash apparently lies partly in the fact that it helps promote a better stand of plants. During severe winters, alfalfa on potash-treated soils withstands the heaving much better than on soils not fertilized with potash. Considering all factors, the application of approximately 250 to 300 pounds per acre of an 0-20-20 fertilizer is recommended previous to the seeding of the alfalfa on the lighter types of soil. Probably, the best method of applying the fertilizer is by means of the ordinary grain drill, drilling as deeply into the soil as possible.

Table 2.—Yields of Alfalfa on a Fox Sandy Loam in Kalamazoo County

Soil treatment	Pounds of dry hay per cutting* Average of 15 cuttings
Lime alone	1,533
Lime and phosphate	1,849
Lime, phosphate and potash	2,125

*From one to three cuttings per year were made

Top Dressing Old Stands

The top dressing of old stands of alfalfa with commercial fertilizer has not been as effective as applying previous to the time of seeding. Should the top dressing practice be tried, it is advisable to wait until after the first cutting has been removed and then apply approximately 250 to 300 pounds per acre of an 0-20-20 fertilizer.

Barnyard manure when used for alfalfa shows excellent returns; however, it seems more advisable to use the manure on non-legume crops which can utilize its nitrogen to a better advantage. Furthermore, various weed and grass seeds are usually found in manure and it is undesirable to seed these with the alfalfa.

CORN BORER AFFECTS FARM MANAGEMENT

Modifications in Farm Business Methods as a Result of the Infestation Are To Be Studied in Southeastern Counties

P. G. MINNEMAN,* FARM MANAGEMENT SECTION AND U. S. D. A. CO-OPERATING

A special farm management study has been started in the major corn growing area in Michigan. This area, located in the southern part of the state, includes Lenawee county which has 21 per cent of its improved land in corn, Monroe with 20, Cass and St. Joseph with 17, Branch with 16, and Washtenaw and Hillsdale counties with 15 per cent each. The agriculture of this region is based primarily upon corn and livestock. Any disturbance which affects either of these becomes an important factor in the agriculture of the area and must be considered in determining the best farm management program.

The corn borer infestation is a disturbing factor in the farming program of this region since it affects the major crop, corn. Some modifications in farming have already been made in this area in order to better combat this insect. It is likely that the corn borer will increase in numbers from year to year and in years favorable to its increase it may cause serious losses.

It was therefore considered desirable to make a somewhat detailed study of the farm organization and operation of selected farms in Wayne, Washtenaw, Monroe, Lenawee, and Hillsdale counties where changes in farm management are taking place as a result of the corn borer. The purpose of the study is to find the best types of farm management for this area. This project does not look to increased production but to more economical production and lower production costs.

As a result, a three-year study was started in the fall of 1929 and 205 of what appeared to be some of the outstanding farmers of the area were visited. Although only about one-half this number of farms will be included throughout the project, it was necessary to visit a large number to permit the selection of the proper proportion of the different sizes and kinds of farms to study throughout the three-year period. Much information relating to the organizations and practices on these farms was obtained at the fall visits and is presented in this report.

It is interesting to note that, although no effort was made to select large farms, the average size of the 205 farms which were visited last fall was 174 acres, or almost twice the average size of all farms for the area. The number of sets of farm buildings on these farms is also an indication of

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consolidation and expansion. Of the 205 farms, 140 had only one set of farm buildings, 49 had two sets, and 16 had three or more sets of farm buildings. In many cases, this indicates that what is now operated as one farm was once two or three farms. Another fact worthy of notice is that of the 182 farmers who were land owners 52 rented additional land to increase the size of their operations.

Machinery Equipment

A great amount of this increase in size of farms is made possible through the use of larger equipment. Of the 205 farms, 150 had tractors, 84 had two-row corn cultivators, 19 had rotary hoes, 10 had mechanical corn pickers, and 4 had combine harvesters. Such large and expensive equipment as combines and mechanical corn pickers require a large acreage in order that the machines may be used at more nearly their capacity.

Six of the 10 mechanical corn pickers were on farms larger than 200 acres. The 10 farms which had corn pickers had on an average 60 acres of corn per farm, while the average acreage of corn on all other farms was 27 acres. The 84 farms which used two-row cultivators averaged 37 acres of corn per farm, whereas those which used single row cultivators averaged 23 acres of corn per farm. Similarly, the 19 farms which used rotary hoes averaged 44 acres of corn per farm, while all other farms averaged 27 acres per farm. The four farms which used combines averaged 132 acres of small grain and soy beans per farm, while all the other farms averaged 38 acres per farm.

Power and Labor Set-Up

The general type of tractor used on these farms was predominately the two-plow, four-wheel type. There were 106 of this type, 30 of the three-plow type, and 19 of the newer general purpose type which is designed to do general farm work, including cultivating. The latter type is increasing in popularity on these farms.

Table 1.—Tractors, Horses, and Man Units on 205 selected Farms in Southeastern Michigan, 1929

Farms grouped in 5 classes	99 acres or less	100 to 149 acres	150 to 199 acres	200 to 249 acres	250 acres or over
Number of farms in the group	43	62	34	36	30
Number of farms with tractor	20	42	27	33	28
Number of farms no tractor	23	20	7	3	2
Crop acres per farm with tractor	60	84	105	127	179
Crop acres per farm no tractor	47	73	87	97	122
Horses per farm with tractor	2.7	3.3	3.4	4.7	5.0
Horses per farm no tractor	2.9	4.1	5.3		.....
Man units per farm with tractor	1.35	1.5	1.9	2.0	2.8
Man units per farm no tractor	1.4	1.6	1.4	....	....
Crop acres per horse on farms with tractor	22.1	26.0	31.2	27.0	36.3
Crop acres per horse on farms no tractor	16.5	17.9	16.5	....	....
Crop acres per man on farms with tractor	44.2	57.3	55.5	63.4	63.5
Crop acres per man on farms no tractor	32.0	45.8	61.8	.....	......

From Table 1, it appears that slightly less than half of the farms smaller than 100 acres had tractors, but that 80 per cent of those containing 150 to

200 acres, and 92 per cent of those having over 200 acres had tractors. Generally, one may say that the use of the tractor has not greatly reduced the number of horses per farm but it has made possible the handling of an increased crop acreage without greatly increasing the labor requirements. In addition to handling a greater crop acreage, the farmers with tractors had the further advantage of getting their work done more nearly at the exact time when soil and weather conditions were most favorable and their crops planted at the proper time.

Crop Practices

An inquiry was also made into the method of harvesting the corn crop. In the fall of 1929, approximately three-fourths of the corn was cut from the land and one-fourth was harvested from the standing stalks. Silage corn comprised 27 per cent; 27 per cent was shredded; 11 per cent was fed in the bundle; and 9 per cent was husked by hand. Of the standing corn, 20 per cent was husked from the standing stalks and about 4 per cent was pastured.

This brings out the fact that, so far as the corn borer is concerned, the three-fourths of the crop which is cut from the land may be easily cleaned up provided that some low cutting attachment is used to cut the stalks close to the ground surface. The other fourth of the crop which is harvested from standing stalks, offers the greatest corn borer problem. In order to do a clean job of plowing under the corn stalks, a wider plow than 12-in. is recommended.

Of the farms included in this survey, 57 used only 12-in. plows for this purpose; 123 used 14-in. plows, 10 used 16-in. plows, 13 used 18-in. plows, and 2 used 22-in. plows to insure clean plowing and complete covering of the corn stalk rubbish.

Among these outstanding farmers, the use of commercial fertilizer was found to be rather general. Only six per cent of the men used no commercial fertilizer during 1929. Wheat was fertilized by 95 per cent of the men; 75 per cent fertilized oats; 63 per cent fertilized their barley, and 50 per cent fertilized some of their corn. These men are firm believers in the use of commercial fertilizers but many of them are not yet satisfied that they are using the right kind of fertilizer for their particular situation.

Crop and Livestock Organization

The typical crop and livestock organization found on the farm of different sizes is shown in Table 2. As is usually the case, the smaller farms have a higher percentage of land in crops than do the larger farms. The

Table 2.—Typical Averages of Various Crops Found on Different Size Farms, Selected Farms in Southeastern Michigan in 1929

Size of farm	Crop acres	Corn acres	Wheat acres	Oats acres	Barley acres	Alfalfa acres
80	54	15	7	10	3	8
120	80	23	10	16	4	12
160	100	30	12	18	6	16
220	124	35	18	22	8	22
320	174	50	20	30	15	29

80 acre farms had about 68 per cent and the 320 acre farms had about 55 per cent of their land area in crops. About 28 to 30 per cent of the crop land was in corn, 12 to 14 per cent in wheat, 18 to 20 per cent in oats, 6 to 8 per cent in barley, and 15 to 17 per cent in alfalfa.

The typical livestock distribution on the different size farms is shown in Table 3. The smaller farms show greater intensity through the comparatively larger number of dairy cows and poultry.

It must be remembered that these figures are not to be taken as averages for the area as a whole, since the farms included in this study were selected as being among the outstanding farms and are therefore considerably above the average in size and in quality of farm business.

Table 3.—Typical Livestock Distribution Found on Different Size Farms,* Selected Farms in Southeastern Michigan in 1929

Size of farm	Horses	Milk cows	Beef	Brood sows	Ewes	Feeder lambs	Hens
80	2.8	5.4		1.3	8		270
120	3.7	8.6		2.2	14	23	200
160	3.9	9.1	4	2.7	16	40	180
220	4.7	11.9	7	3.0	36	60	160
320	5.0	13.6	10	5.6	50	80	140

*The above distribution of livestock is on the basis of all farms having some of each kind of livestock which is, of course, not the case.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
80 Yellow Rocket (a dangerous weed).
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
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110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
119 The Septic Tank and Sub-Surface Tile Sewage Disposal System.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.

123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
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130 The Clovers and Clover Seed Production in Michigan.
133 Fertilizers. What they are and how to use them.
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138 Rural Highways.
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161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.

†164 Diagnosing Orchard Ills.
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189 The Marketing of Michigan Milk.
190 Oak Forests of Northern Michigan.
191 Barley for Michigan Farms.
192 Causes and Effects of Soil Heaving.
***194 The Use of Peat in the Greenhouse.**
***195 Maintaining the Productivity of Cherry Trees.**

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†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

*Bulletins listed in bold faced type are recent publications of this Station.

Circular Bulletins—

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***133 Soft Scales Injurious to Deciduous Ornamentals.**

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